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ARE WE TO BECOME AFRICANIZED?

By HENRY GANNETT.

DURING the past few months the presence of the negro in the United States, his future, and his possible influence upon our social and political fabric, have become a fertile subject of discussion. Thus far the argument has tended entirely in one direction, all writers seeming to be agreed that the country is rapidly getting into a bad way, by reason of its millions of black laborers. Various remedies have been prescribed, all of them more or less difficult to apply.

It would appear that the wisest course to pursue would be to first study the case thoroughly, and make sure that the alleged patient is really ill, before pouring into him any nauseous draughts. It is possible that he is merely a hypochondriac.

In "The Popular Science Monthly" for February, 1883, there appeared an article by Professor E. W. Gilliam, entitled "The African in the United States," in which, by a free handling of the statistics of the last two censuses, the author attempted to prove that the colored race is increasing in this country at a much more rapid rate than the whites, and that consequently, unless some effectual preventive measure against this increase be taken at once, we are in imminent danger of becoming Africanized. He proposed, as the cure for the impending evils, a wholesale, forced migration of the colored people.

This article is re-enforced by another from the same author, in the November number of the "North American," in which the same views are reiterated.

As these articles have attracted much attention, it is desirable to notice them in some detail. The argument upon which Professor Gilliam bases his conclusion that the negroes are increasing faster than

the whites runs as follows: During the decade 1870–'80 the whites increased, upon the face of the returns, 29 per cent, and the blacks 34 per cent. From the former rate of increase he subtracts 9 per cent, to account, as he says, for foreign immigration, leaving 20 per cent to represent what he calls the native increase. From the per cent of increase of the blacks, he deducts 5 per cent to allow for his surmise as to the extent of omissions in the ninth census, "leaving 30 per cent" (*sic*). Then he restores the 5 per cent, making a normal rate of increase of 35 per cent for the blacks, on the ground that in the future they will increase more rapidly than in the past. It can not be denied that, with these rates of increase for the two races, Professor Gilliam is well equipped for the task of Africanizing the country, and, if these figures, or any approach to them, are correct, we may well feel anxious for the fate of the "white man's government."

With these figures as a basis, Professor Gilliam goes on to predict the population a century hence, with results as follows: Northern whites, 240,000,000; Southern whites, 96,000,000; Southern blacks, 192,000,000.

An analysis of the author's curious method of deducing these results will, however, aid to dispel this frightful vision of the future. The increase of white population between 1870 and 1880 was slightly less than ten millions. The number of immigrants during this period was a little in excess of two million eight hundred thousand. Subtracting the latter from the former, there is left a number which is 23 per cent of the population in 1870, not 20 per cent, as Professor Gilliam has it. But what does this 20 or 23 per cent (it matters not which) represent? Certainly not the increase of native whites, as he interprets it. The census gives directly the numbers of native whites in 1870 and in 1880, and the proportional gain of this class during the decade was not less than 31 per cent. These are the figures which he should have used in making his comparisons.

Now as to the increase of the colored element. Professor Gilliam, at the outset, deducts from its rate of increase 5 per cent, representing about a quarter of a million persons, on account of the imperfections of the census of 1870. Concerning the omissions of this census little is known, except that they were generally distributed through the cotton States, were largely, if not mainly, of the colored element, and, of that element, approximated nearer three fourths of a million than one fourth, and certainly exceeded half a million. Professor Gilliam's subsequent addition of 5 per cent, "as an obvious consideration points to the conclusion that the blacks will for the future develop in the South under conditions more and more favorable," certainly is not warranted by the facts or the probabilities, and, as we are reasoning from what has been and is, and not from what may be, it looks very much like begging the whole question.

Correcting Professor Gilliam's statements, it appears that the ratios

of gain during the past decade were, as nearly as can be known, as follows: For native whites, 31 per cent; for blacks, not above 25 per cent.

But all such comparisons, based upon the results of the ninth census, are utterly worthless. No reliable conclusions regarding the increase of negroes can be drawn from a comparison in which these statistics enter. The extent of the omissions can be a matter, within certain wide limits, of conjecture only. The only comparisons which yield results of any value are those made between the statistics of the eighth and tenth censuses. That the former was, to a certain slight extent, incomplete, is doubtless true, especially in regard to the colored element, but the omissions were trifling as compared with those of the ninth census. A comparison between the results of the eighth and tenth censuses shows the advantage to be clearly in favor of the native whites, who increased 61 per cent in the twenty years, while the colored element increased but 48 per cent. This great increase of the native whites was effected in spite of the fact that the ranks of the adult males were depleted to the extent of over a million by the casualties of war, which the negroes scarcely felt.

This relatively greater increase of the whites is sustained by the record during the days of slavery. In but one decennial period since 1790 did the negroes increase as rapidly as the whites, and in most cases their increase was far less, as appears in the following table, extracted from Scribner's "Statistical Atlas":

DECADE.	PERCENTAGE OF INCREASE.	
	White.	Colored.
1790 to 1800	35·76	32·38
1800 to 1810	36·13	37·46
1810 to 1820	34·12	28·57
1820 to 1830	34·03	31·41
1830 to 1840	34·72	23·28
1840 to 1850	37·74	26·61
1850 to 1860	37·69	22·06
1860 to 1870	24·76	9·86
1870 to 1880	29·21	34·85

It will be noticed that the only period during which the colored element increased faster than the white element was between 1800 and 1810, during the continuance of the African slave-trade, which ceased in 1807. It will also be seen that the rate of increase of the negroes, while irregular, shows a marked and rapid decrease—a much greater decrease than that of the whites—even up to 1850, when immigration from Europe began to make itself felt.

This decrease of the colored race in proportion to the whites is set forth still more strongly in the following table, quoted from the same work:

CENSUS.	PROPORTION OF—	
	Whites.	Colored.
1790	80·73	19·27
1800	81·13	18·87
1810	80·97	19·03
1820	81·61	18·39
1830	81·90	18·10
1840	83·17	16·83
1850	84·31	15·69
1860	85·62	14·13
1870	87·11	12·65
1880	86·54	13·12

Between 1790 and 1860 the proportion of colored to total population is seen to fall from over 19 per cent to but little in excess of 14 per cent—a decrease of fully one fourth. In the half-century which elapsed between the date of the first census and 1840, during which time immigration was very slight, it decreased not less than $2\frac{44}{100}$ per cent, although for one third of this period the slave-trade was being carried on.

Such being the history of the negroes in *ante-bellum* days, when they were property, and when every consideration of self-interest prompted their owners to watch over their health, to encourage child-bearing, and to protect and preserve the children, is it to be supposed for a moment that this careless, improvident, ignorant race, thrown suddenly upon its own resources, should at once, or within a generation, take on a rate of increase more rapid than before emancipation? The wonder is, that in the past twenty years they have not fallen further behind.

Considering the colored race in this country as a whole, it is seen that it has not held its own, either in a state of slavery or thus far in freedom. It is but another illustration of the fact, that an inferior race can not thrive side by side with a superior one. It would seem, therefore, under the circumstances, more profitable to study ways and means for preserving and strengthening the manual labor element of the South, rather than to debate the methods of getting rid of it.

In "An Appeal to Cæsar," by Judge Tourgee, the question of the future of the colored element is discussed from a somewhat different point of view. Without committing himself as to the increase or decrease of the colored element in the country at large, in proportion to the whites, the author finds, upon a somewhat superficial study of the statistics bearing upon the question, that in the South Atlantic and Gulf States the negroes have increased decidedly in proportion to the whites, while in those States which he classes as border States they have relatively decreased. This massing of the negroes in what may, for convenience, be denominated the cotton States, coupled with the steady sharpening of the line of separation between the two races—a line which, as the author claims, becomes more and more accentuated

as the inferior race increases in numbers and advances in education—will lead to inevitable conflict between the two races. As the negro becomes numerically the stronger, and, through education, appreciates more fully his present position, he will commence a struggle for the mastery, and then the days of the Ku-klux will be eclipsed in blood and slaughter. Such is the condition to which these ill-fated States are hurrying. To ward off this impending evil, Judge Tourgee urges upon the General Government the work of educating the blacks. Such, in brief, is the "Appeal to Cæsar."

Education seems to be regarded as a universal panacea for all the ills of the people, but in this case, according to the author's own statement of the situation, the education of the negroes would but precipitate the impending conflict. Our only safety would seem to be in leaving them in ignorance.

The whole "Appeal" is based upon the theory that the negroes are migrating southward from the border States into those of the South Atlantic and the Gulf in great numbers. This theory the author attempts to establish by deductions from census statistics.

It may, in passing, be suggested that a careful revision of his figures will show many important arithmetical errors, which may modify very sensibly some of his conclusions. It is unnecessary to follow his methods of reasoning, as the truth regarding the questions at issue can be arrived at much more directly. The fact is, that the negro is not migrating southward. There is no massing of the colored people in the cotton States. In 1860 the colored element of these States formed 66 per cent of the colored element of the country. In 1880 it formed precisely the same proportion. Between 1860 and 1880 the colored element of the country increased 48 per cent. The same element of the cotton States increased, in this interval, in precisely the same proportion, neither more nor less. These figures are conclusive upon this point, and from them there is no appeal.

But the fact remains that, in these cotton States, the colored element was in 1880, in comparison with the white element, slightly stronger than it was twenty years before. This, however, is due not to a southward movement of the colored people, but to a decrease in the rate of increase of the whites of those States. While the increase of the native white population in the country at large between 1860 and 1880 was sixty-one per cent, that part of the same element resident in the cotton States increased but thirty-nine per cent. This low rate of increase among the whites might seem to establish Judge Tourgee's position, though not in the way he states it, were it not for the fact that three fourths of this increase took place during the decade between 1870 and 1880. The increase of whites in the South received a most effectual check during the four years of war, in which every male capable of bearing arms was in the field, and in which fully half a million laid down their lives. Since the war the white

race has taken up a rate of increase equal to, if not greater than, that of the country at large, a greater rate than that of the colored people within its borders, and there is no apparent reason why they should not maintain it. It is not, then, a migration of the negroes southward which has caused their relative gain in these States, but it is the losses of the white race—losses which, however, are rapidly being repaired.

As the negroes are not increasing as rapidly as the whites, either in the country at large or in the cotton States, and therefore are destined to become constantly of less numerical importance, the pressing necessity for doing something to ward off the evils predicted by the authors above quoted does not appear to exist.

THE NERVOUS SYSTEM AND CONSCIOUSNESS.

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III.

WE are beginning to hear lamentations over the realism of our time. Not only are the gods dead, God is dead. Art finds no place for Imagination, save in setting her to devise ways and means for a more complete photographic process. Among the crimes laid to the account of Science, *this* is not the least; indeed, perhaps this may sum them all, that she has taken away our Lord and will show us nothing in return but the geologic formation of a sepulchre. While this charge is unjust, radically unjust, it must be allowed that the manner of commendation employed by many advocates of science is responsible, in large measure, for our bread-and-butter attitude. The fault lies in the original constitution of certain men—not that they are scientists, but that they are small scientists; men for whom a formula, or a compound, or a root, or a fact whatsoever, is the end. To know the most names of the most classifications is to be saved, to apply chemistry in the manufacture of salable beer is to make "calling and election" sure. The devotion of these little men to science is not only at the expense of all that is highest, but is, as was intimated, largely responsible for the realism over which so many weep. Men of science, that is to say *men* of science, are not accountable for deadness of soul. The wonder with which those early Greeks looked out upon the face of all things may not for one instant be compared with the wonder that fills the soul to-day before this stupendous universe:

"Die Geisterwelt ist nicht verschlossen:
Dein Sinn ist zu, dein Herz ist todt."

Because we have learned that color is not in sunset or rose, is there therefore no color? Is the marvel anywise diminished by knowing

that, upon matter so adjusted and so acting as the brain is adjusted and acts, all color depends? Because there is no sound in bell, or breeze, or ocean, is there therefore no sound? And wherein is the wonder of it diminished when we have learned the construction of the ear, its possible relation to a particular fold in the brain, and the necessity of this for all the harmonies that fill the soul with glory? Are we, the thinking, sorrowing, hoping selves, any the less real because *all* this thinking, all this sorrowing, and all this hoping depend in strictest sense upon that most highly organized form of matter the human brain?

George Eliot spoke truly when she said, "To advance in knowledge is to outline, more perfectly, our ignorance"; and who does not wonder before the unknown? When man is brought, as, if he is capable of it, science will bring him, face to face with the darkness of mystery, does he boast himself of all that he has learned? We may rest assured that the glory of mystery has not departed from off the face of the heavens or of the deep. I know not where this mystery is greater, or the wonder of it more manifest, than in the relation which obtains between the brain and consciousness, between the brain and the personality that thinks and feels and wills. This relation is a fact. All that we call our soul-life, from the sensations, the "building-stones" of this life, to the most abstract thought and holiest desire, stands dependent upon the activities of nerve-matter. Surely no one will be led to say, so are these things dependent on stomach, lungs, and heart. *Such* dependence is indirect, mediate, the other direct and immediate. Between consciousness and the brain, between nerve-matter and ourselves, there is a relation close, constant, immediate; we may well strive to reason upon the character of this relation. Here at the outset, this term reason must have clear meaning. I intend to use the word as expressive of the process of inferring, of drawing a conclusion from premises. I have now no concern with those who intuitively perceive truths beyond the territories of sense and inference. Those for whom the immateriality of the soul is a direct deliverance of consciousness may smile at the crawling pace of my induction; still, it is an honest and a needful endeavor to search after those conclusions respecting brain and consciousness which the inductive, inferential process shall necessitate.

In such search, nothing, as I think, is more important than to be assured that, in reasoning from the knowledge given by our senses to conclusions which transcend such knowledge, we must proceed according to *discerned resemblance.*

Two things agreeing with, which means, for us, resembling, one and the same third thing, agree with, that is resemble, each other; and two things, of which one agrees with, that is, for us, resembles, and the other does not agree with, that is, for us, does not resemble, a third thing, do not resemble each other. If the manifestations of

nerve-matter and the manifestations of consciousness disagree, seem *unlike* after our best examinations, it is unreasonable to give them a common cause; they can not, by us as rational beings, be brought into such close relation.

Permit me to ask attention to a further consideration. Neither the direct knowledge given by our senses, nor this inferred knowledge, furnishes a solution of the mystery which belongs to the subjects we investigate. It is often said and as often forgotten that all explanation of natural processes consists solely in the resolution of involved combinations of activities into their elements. We make a false demand of the evolutionist when we insist that he shall tell us *how* the biological is evolved from the a-biological, and he makes a false demand of the spiritualist when he requires to be told *how* mind acts on brain or brain on mind. There is no such thing as being told the how of what takes place. The starting-points are unknowable in their nature and in the reasons of their operations. If I have not completely misunderstood that vigorous book, "Modern Physical Concepts," the purpose of its writer was to show that the so-called bases of physical science do not represent *entities* any more than the terms vitality, justice, humanity, law, represent entities, but that the bases of physical science stand for the *present* highest generalizations of the mind working inductively, that these bases do not exist out yonder among the spaces, but here within the thinker, and that when we affirm matter to be, outside of us, *exactly* thus and so, force exactly thus and so, we are but repeating the mediæval procedure of declaring that beneath the oak-tree there is an oak nature, beneath human beings a human nature. Judge Stallo, as I think, found the mind at its old trick in modern physical science, the trick of actualizing, and thrusting out yonder into space, its thoughts, its concepts, and of worshiping them as lords of all, explainers forever. Service is rendered here, not for orthodoxy as against heterodoxy, not for spiritualism as against materialism, but for all truth as against all error. We need to keep in mind that the only thing which can be accomplished by science, or by philosophy, as the unification of the sciences, is a detection and expression of resemblance between phenomena and between the modes of their activity. This may give us a law of evolution extending over *all* manifestations, a law not perched up on matter compelling it to evolve, but a law expressive of our feeling of similarity where we had previously felt diversity.

This resemblance is detected by *observation*. Now, observation is a process, not a thing. Its character is never determined by the object observed. Observation is not an instrument possessed by the physicist alone. Observation is an *intellectual* operation, and may be as genuine, as honest, when directed to thoughts, emotions, volitions, as when brought to bear on stars, rocks, or brains. The time has come when the truth shall assert itself that philosophy is an attempt

to *unify all* our experiences, an attempt to be able to say that whereas here and here and here my experiences seemed unlike, separate, they now seem alike and conjoined.

The application of all this to man is plain ; indeed, has been for these past years most impressively operative. Formerly, man was supposed to possess an intellectual and moral nature distinct in kind ; in him was thought to reside a force peculiar, above and beyond all other forces. Observation has had much to say, as many believe, in contravention of these conclusions ; and it is now well known that the doctrine of evolution is brought to bear on all sides of human psychology in a way special and searching. I have not here in mind the work of Spencer or Bain, or their immediate disciples. Within very recent days books have been published which show painstaking research in distinct psychological departments. Ribot has discussed the physiology and pathology of memory ; Grant Allen has offered help in the "tangled territory" of æsthetics ; Leslie Stephen has written a science of ethics, stating as his purpose, "to lay down an ethical doctrine in harmony with the doctrine of evolution" ; G. H. Schneider, author of a work on the animal will, has just published a careful treatise on the human will from the stand-point of the modern development theory ; Professor Preyer, at Jena, has set out the results of his observations on the soul of the child—observations made with greatest care three times each day during the first three years of child-life. I might extend my list at length ; for this there is no need. We are face to face with the question of the relation between brain and consciousness. I have said that this relation is positive and constant, though few, except physicians, realize the meaning of such a fact. It means, in the first place, that changes of consciousness coincide with molecular changes in the brain. For every alteration in consciousness, however slight and transient, there has been a molecular change in the brain. This relation means, in the second place, that there is a physical basis for memory. Whether we accept or reject localization of functions in the cerebral hemispheres, we must believe that the cell-modifications which coincide with specific sensations remain permanently, thus furnishing a physical, organic requisite for memory. In the third place, this relation means that, in a recollection of any of our experiences, there is presupposed a renewed activity of those very portions of the brain which assisted in the experience. There are no transcendentalists so transcendental that they may transcend this direct relationship between what they are pleased to call gross matter and their sublimest ecstasy. What opinion must we form as to the nature of this relation ?

We have choice of two conclusions which are alternatives. We may say the relation of brain-matter and consciousness is one of correlation, conversion—or we may say it is one of instrument to personality. Personality is here, as everywhere, a term chosen to represent a series of manifestations so alike among themselves and so unlike all

other manifestations as to necessitate a specific designation. By adopting the term personality, we should affirm our belief in the existence of some form of being, which, *for us*, is persistently unlike every other form of being with which we come into relation. Here the element of *speculation*, which is a necessary part of all reasoning, appears. Whether we accept correlation or personality, we accept what can no more be *directly known* than the mortality of men now living, or the return of the seasons. All reasoning is beyond the facts, and is in this a speculation; but reasoning need be no more an unsafe guide on such subjects as the one before us than on any of the complex affairs where we gladly trust its teachings. Our demand of Reason must be that, though she lead us beyond the facts, she shall never lead us *contrary* to the facts. Again, I would say, it should be recognized that neither of the conclusions above indicated is a solution of the mystery attendant upon consciousness. The pride of the little scientists induces them all too often to declare that, by the first of these alternatives, they have cleared away the obscurity which they love to call metaphysical and let in the white light of comprehension.

So, in turn, the other party, seizing hold of the fact of personality, forthwith affirm that, by it, man's immateriality, immortality, and divinity, are forever made visible in the light of consciousness. All this is quite aside from that inferential process which, as reasoning beings, we should prescribe for ourselves. Is the relation between brain and consciousness one of correlation; may we, according to the evidence, believe it to be one of correlation? Physiological materialism is an extension of the doctrine of correlation to consciousness. It is needful to know what is meant by correlation. Correlation is a *necessary, reciprocal production.* "Any force capable of producing another may be produced by it. Each mode of force is capable of producing the others, and none of them can be produced but by some other as an anterior force. The various affections of matter, heat, light, electricity, have a reciprocal dependence; either may produce or be convertible into any of the others." The materialism of physiology extends this doctrine of correlation to consciousness. The well-worn language of Professor Huxley ("Darwin and his Critics") is again in point. "As the electric force, the light-waves and the nerve-vibrations caused by the impact of the light-waves on the retina are all expressions of the molecular changes which are taking place in the elements of the battery, so consciousness is, *in the same sense*, an expression of the molecular changes which take place in that nervous matter which is the organ of consciousness." A short sentence from Dr. Carpenter to the same effect: "*There is just the same* evidence of what has been termed correlation between nerve-force and that primary state of mental activity which we call sensation that there is between light and nerve-force." Now, the proposition, fundamental to my paper, is that such a conclusion can not *rationally* be drawn, un-

less the characteristics of consciousness, as we know them and are obliged to know them, *resemble* the characteristics of brain-activity as we know them and are obliged to know them. It will not avail to say there are striking differences between heat, electricity, and light; there are striking resemblances—one positive, constant resemblance—they are all modes of *motion*. Between the characteristics of consciousness and the characteristics of nerve-matter, as we know them, *there are no resemblances whatsoever*. If the smaller physiological materialists (for the larger do it fully) would but think it worth their while, and a truly scientific procedure, to fasten their attention upon consciousness, they might be struck by its peculiarities. The distinctive features of consciousness in general have often been indicated. I shall restate them here as they have been compared with nerve-activities, arranging them in pairs for the sake of clearness:

1. *Nerve-activities:*
   All are modes of extension and motion.
   Consciousness-activities:
   None can be conceived as extended or moving.
2. *Nerve-activities:*
   They may be observed through the senses.
   Consciousness-activities:
   They are never known through the senses.
3. *Nerve-activities:*
   They are external to the observer.
   Consciousness-activities:
   They are internal to the observer.
4. *Nerve-activities:*
   Each may be directly seen at the same time by many observers.
   Consciousness-activities:
   They can be directly known by one person only, viz., he who experiences them.
5. *Nerve-activities:*
   They consist of parts external to each other and are divisible.
   Consciousness-activities:
   They have no distinction of parts and are indivisible.

It may surprise some readers to be told that this contrast is fully recognized by many leading upholders of evolution. Mr. Spencer says, "There lies before us, in the study of consciousness, a class of facts absolutely without any *perceptible* or *conceivable* community of nature with the facts that have occupied us in the study of the nervous system."

Dr. Tyndall ("Address on Scientific Materialism," Norwich) says: "The passage from the physics of the brain to the corresponding facts of consciousness is unthinkable. The chasm between the two classes of phenomena is *intellectually impassable*." Professor Huxley says: "I know nothing whatever, and never expect to know anything, of the

steps by which the passage from molecular movement to states of consciousness is effected. I entirely agree with the sense of the passage from Dr. Tyndall."

In view of the dissimilarity, the *thorough* dissimilarity, between nerve-activities and consciousness-activities, we are not justified in regarding the former as the *sole* cause of the latter. Chemists, after a somewhat protracted examination of the substances found in nature, announce the discovery of sixty-four *different* bodies, from which they can not, by any means *now* at hand, separate simpler substances. This does not intend to say that these sixty-four elements are absolutely simple, but that "they are so as far as our knowledge extends." Now, why are these sixty-four elements maintained to have a real existence? Why is aluminium believed in as a fact distinct from antimony, or arsenic as a fact distinct from bromine, and so on throughout the list? Because, and simply because, the states of consciousness are persistently distinct when dealing with these so-called elements. The chemist is unable to experience resemblance between the actions—i. e., the manifestations—of aluminium and antimony. *Therefore*, and therefore alone, he says, there *are* here different substances.

This is the kind of reasoning, and no other, that we wish applied to the subject of our examination. If the passage between brain-activity and consciousness-activity be unthinkable, intellectually impassable, why is it so? Not from any *a priori* or "high-priori" inconceivability, but because these activities persistently fail to resemble one another, i. e., to produce in us similar states of consciousness. They can not be rationally called "diverse operations of energy mutually convertible like light, heat, and the other physical forces." Such correlation is opposed through and through to experience. Here is the irrationality of physiological materialism. This materialism makes a break in the physical continuity of Nature's workings; a break found nowhere else; a break, moreover, which is not found here by any examination of which we are capable.

Correlation requires that motion should be transformed into something not motion, and then resume its course as motion. Motion set up at the periphery of the body produces a definite and measurable quantity of motion in the brain; this is well called a mechanical problem out and out. We find no measurable consciousness, yet consciousness is a reality; we find no break in physical processes elsewhere, yet, if correlation be true here, such a break there is. It will, I hope, be clearly seen that this difficulty is nowise related to the old and worthless difficulty thought to be suggested by those who ask the materialist *how* motion is transformed into consciousness. As to the how of things they have learned most who have learned that they know nothing. The question is not how are brain-motions transformed into consciousness, but the question is exactly this, What ground have we to believe that such transformation exists?

Permit me to repeat the statement that there is no reasoning here along the "high-priori" road of inconceivability. I see no more inconceivability in supposing that a brain-change should be followed by a thought than that it should be followed by an increased secretion. The thing needed is, to know the fact in the case. Are brain-changes transformed into consciousness, or does the soul, on occasion of these changes, respond in its peculiar language?

The brain-changes, as we know them and must know them, consist of attractions, repulsions, motions, and co-ordinations of the brain-particles. These, according to the physiological materialist and the young physician, are transformed into states of consciousness, which states are not material changes, but separated from them by a chasm "intellectually impassable." It has been wisely said that the position which a thorough-going scientific evolution ought to defend is this: thoughts, feelings, volitions, any and all states of consciousness, have no existence for physical science. Indeed, the annoyance caused by consciousness as a useless "surplusage" is nowhere more strikingly illustrated than in the following passage from Professor Huxley's paper "On the Hypothesis that Animals are Automata." The author writes: "Though we may see reason to disagree with Descartes's hypothesis that brutes are unconscious machines, it does not follow that he was wrong in regarding them as automata. We believe, in short, that they are machines, one part of which (the nervous system) not only sets the rest in motion and co-ordinates its movements in relation with changes in surrounding bodies, but is provided with special apparatus, the function of which is the calling into existence of those states of consciousness which are termed sensations, emotions, ideas. It may be assumed, then, that molecular changes in the brain are the causes of all the states of consciousness in brutes. Is there any evidence that these states of consciousness may, conversely, cause those molecular changes which give rise to muscular motion? I see no such evidence. The frog walks, hops, swims, quite as well without consciousness as with it, and if a frog, in his natural state, possesses anything corresponding with what we call volition, there is no reason to think that it is anything but a concomitant of molecular changes in the brain which form part of the series involved in the production of motion. The consciousness of brutes would appear to be related to the mechanism of their body as a *collateral product* of its working, and to be as completely without any power of modifying that working as the steam-whistle which accompanies the work of a locomotive-engine is without influence upon its machinery. Their volition, if they have any, is an emotion (?) indicative of physical changes, not a cause of such changes. It is quite true that this reasoning holds equally good of men, and therefore that all states of consciousness in us, as in them, are *immediately* caused by molecular changes of the brain-substance. It seems to me that, in men as in brutes, there *is no proof* that any state of consciousness is the

cause of change in the motion of the matter of the organism. If these positions are well based, it follows that our mental conditions are *simply the symbols* in consciousness of the changes which take place *automatically* in the organism, and that, to take an extreme illustration, the feeling (?) we call volition is *not* the cause of a voluntary act, but a symbol of that state of the brain which is the immediate cause of the act. We are conscious automata." (The italics in the above quotation are the present writer's.) This passage, published in 1874, will remain unique as an attempt to "get on" in our examination of man without consciousness. Consciousness is a collateral product of brain-change. Whatever may be meant by "collateral," it can not be so one-sided an affair as to save the break in physical continuity previously described. If consciousness be at all the product of brain-changes, it appears, and must appear, as a stranger to these changes, destitute of a single one of their features. Further, and with sincere deference, I would say that the reasoning in the passage before us seems to me peculiar. Consciousness is produced by brain-changes; nay more, these are the sole cause of consciousness, and yet there is no ground to believe that consciousness in its turn ever occasions brain-changes or muscular movements. Volition is not the cause of a voluntary act, but a token that such an act is taking place. This would be termed in logic a contradiction, both in form and matter.

When we are told that consciousness is completely without the power of modifying the working of our body, we do, indeed, feel that consciousness might as well give up and cease to be; at the same time we know that consciousness, in the shape of volition, is adjusting, directing, and in manifold other ways modifying our organism from day to day. My reason for bringing up this disposition of consciousness was not so much to show its deficiency (which has been well done by Dr. Carpenter and others), as to insist upon the fact that consciousness is not susceptible of scientific treatment by any physical or physiological method. I wished also to show that no half-way recognition of consciousness would meet the demands of investigation. Perhaps the chiefest benefit to come from the physiological psychology of our day will be in this, that it will make unmistakably clear its own inadequacy for a treatment of consciousness as such. I trust I may not be misunderstood in this remark. I yield to no one in the belief that an inestimable advantage has been conferred on psychology by physiology. It is now possible to study the sensations, both general and special, with a thoroughness unknown a few years since. The intimacy of connection between brain-changes and what we term soul-states has been once and for all established and proclaimed. Much may be accomplished toward a localization of functions in the hemispheres; the time may even come when people at large shall know that most of their stupidity, peevishness, and sin, results from unhealthful brain-activity. The relation between digestion, ventilation, sleep, and morals, may

attain general acceptance, to the destruction of a huge load of the world's misery. All this and more may come, but physiology will never remove or investigate a state of consciousness; it will never front the inner side of a single sensation. This, if I mistake not, is the annoying thing to many specialists. The resort has, for a long time, been a vigorous pooh-poohing of consciousness, or a ridicule of it as somehow synonymous with metaphysics and nonsense. It is a singular and natural thing—singular in its intensity and narrowness, natural in its origin—this conviction among many of the younger specialists that logical and psychological investigations are but rattle-boxes for babes and fools. The natural origin of this, I say, is plain. The chairs in many of our colleges and universities are occupied by men nobly endowed by nature for their special studies, and cultivated through years of investigation abroad. They have not, however, escaped the working of the association of ideas. All they have ever known about psychology, logic, or ethics, dates back to a few hours' perfunctory stumbling over the pages of Haven's "Mental Philosophy," Day's "Logic," Whately's "Logic," Thompson's "Outlines of the Laws of Thought," Butler's "Analogy," Haven's "Moral Philosophy," or, if specially fortunate, Hamilton's "Metaphysics." These exercises in torture were held during those groping years of college-boy experience. Here were given all the facts ever furnished for coming to an understanding of the processes of thought or the principles of morals. Interest in these matters, an interest natural to all who share human nature, was blasted at the outset of its development. Other pursuits that could and did take on the semblance of reality fastened attention, and led to the years of toil that fitted for life-work. What more natural than that henceforth (must it be said forever?) each approach to the subject of consciousness is, for these minds, an approach to confusion worse confounded? The fact that I occupy a chair in Philosophy will very much weaken the force of what I am about to say; still, the conviction will get itself expressed with whatsoever power it may have. The work of the workers would rise faster, stand firmer, come to more universal recognition, if guided by some living logic, and some appreciation of the processes of thought, emotion, and will. The fact is, that in consciousness and in consciousness alone all things are known. No physicist ever fronted or ever will front a *pure* fact, a thing as it is, apart from consciousness. What the physicist knows are not substances *in themselves*, out of consciousness. Force and matter are, in the way in which he uses them and must use them, products of his consciousness. He, the conscious person, is affected so and so, that is, is made to have such and such states of consciousness; to the *common* or resembling elements in these states, he gives a common name, believing, beyond a doubt, in the existence of a cause for these states, but often failing to realize that such cause is unknown and unknowable, not at all revealed, in its essence and apart from consciousness,

by the abstract terms which he has formed to express it. The physiological materialist can never meet the demand which a proof of his belief requires, viz., that he should be able to consider the nervous system apart from consciousness before declaring it the sole cause of consciousness. All that is known of the nervous system is known through consciousness; is there, then, no importance, no necessity, for some examination of consciousness for those who would give an account of their knowledge, be its content what it may? This position, rightly understood, will vindicate my assertion that, for all forms of investigation, the need at present is a critique of knowing, a critique which shall be not simply a "Zurückgehen auf Kant" (profitable as this might prove for an understanding of his relation to materialism), but a critique which shall embody the contributions of recent years from investigators in the territories of the senses, the understanding, and the emotions.

It may be asked, Why should this appeal for consciousness come so late in the present discussion? Ought it not rather to have preceded the statement of the characteristics of consciousness, and so prevented a break in the course of thought? Such a break is, of course, undesirable; still, it is one not to be avoided, as I think, under the circumstances.

There remain for consideration certain special features of consciousness, for whose examination and estimation special entreaty was needed. This solicitation will have more force when placed in direct connection with the features themselves. The writer ventured to hope that those broader, more noticeable characteristics of consciousness which lie, as it were, upon the surface, might be left to awaken attention by their size. Not so with matters now to be brought forward. While there is no purpose to leave, even for an instant, the territory of experience, we enter a portion of that territory which, to many, will be new, and therefore, without effort against prejudice, untrue.

There are certain special facts in consciousness, i. e., certain distinctive features in each person's experience, which prevent, out and out, the acceptance of correlation as a proper account of the relations between brain and consciousness. Few would refuse to admit that sensation is a fact, yet there is danger of studying sensation with the sensation omitted.

Every sensation has four physical antecedents which, though distinct, are not different in kind from one another. This is such a preponderance of the physical that the other element is likely to go unnoticed. The physical requisites for every sensation are: 1. Some outward, exciting cause or excitation—this is physical movement, nothing else; it may be of ponderable matter or of an imponderable instrument, as light. 2. The contact of this physical condition of movement with a sensitive portion of the body. 3. The excitation-

condition of the sensitive nerve-fibers. This is produced by the outward irritation, but is a purely physical and inward nervous process, having no other resemblance to its cause than that it is motion, and having *no resemblance* to the *sensation* which is conditioned upon it. 4. The transfer of this condition of the nerve-fiber to the central parts of the nervous system, especially to the brain. These are the mechanical antecedents for sensation. They are susceptible of physical treatment. They may, and often do, operate without any sensation arising; more than this, they may operate so as to produce a reflex activity, causing violent motions, still without the faintest appearance of sensation. It is plain, then, that to know anything about sensation we must pass from physiology to personal experience. It seems a just charge against the materialism of physiology, both general and medical, that it takes no account of *the* element in a sensation-process.

How shall we escape saying that the last step in this process is the sensation itself, which the soul calls forth from itself in consequence of the antecedents described? The sensation is no picture of the outer thing, the retinal image works, in all probability, chemically upon the retina, but that image does not and can not get itself transferred to the cerebral hemispheres. The sensation is an answer to the excitation in the brain-mass, arising from that image, an answer in such peculiar language that it must be called language of the soul—not as thereby explaining it in the sense of resolving its mystery, yet as thereby explaining it in the only way in which explanation is *anywhere* possible, viz., by resolving the combined activities into their elements.

It is a necessary part of this discussion to note that one of these elements is personality, i. e., a consciousness of the sensation as *mine*. It seems unfortunate that, in dealing with this experience of personality, the strength and weakness of the development theory are not rightly estimated. The strength of the theory lies in those rudimentary sensations connected with infant life, and with the organic processes where it seems but just to say that only *feeling* is present, i. e., no true consciousness, no knowledge of the sensation as mine. The weakness of the theory, and it is a fatal one, lies in the failure to recognize the distinction between a matured idea of self which comes only with years, and a consciousness that the sensation is mine, however rudimentary this sensation may be. The most primitive distinctions in consciousness, those of pleasure and pain, can not be experienced without being known. When this is realized, the inadequacy of the attempt to dispense with personality, or to derive it from anything more elementary than itself, must appear; the two factors in every phenomenon, viz., that which manifests itself, and that to which it manifests itself, are at once disclosed.

Memory, which, though lying in the so-called fog-land of consciousness, is yet a reality, has been brought forward as decisive against the application of evolution to the origin of knowledge. Memory is a pre-

requisite for all psychical development. Unless we can compare the experience of yesterday with the experience of to-day, any advance of ourselves from the brute condition is impossible. Now, such comparison demands that the *first* experience should have been known as mine. From this demand there is no escape. Complying with it, something, some form of being called personality, must lie at the bottom of the inner side of our nature. Lotze has pertinently said: "We have this unity of consciousness not because we *appear* to ourselves to have it; we have it because we appear to *ourselves* to have it."

In each sensation there is consciousness of self in a particular state. Our sensations are varied and successive. We hear the sound of a bell, then of a railway-train, then of the wind; we see cloud, moon, and mountain-top. Here we have the sensation, the succession of sensations, the discrimination of sensations, and discrimination of things by the sensations. Devolve this whole business upon nerve-matter in the cerebral hemispheres. Is such ascription of functions rational? Is it in keeping with our knowledge of brain-structure? If we surmount the difficulty of transformation of motions into non-motions (that is, consciousness), what provision do we anywhere find in the hemispheres for the *unification* of such sensations as above described, their unification in self?

A further question at once arises. Physiology has arranged for diversity of result. What has it done toward comparing these differences? By comparison, and by that alone, each sensation is known as distinct from every other. All that physiology offers or can offer is the integrity of each nerve-fiber. As has been justly said, this fiber is like every other in construction and action. What provision have we, apart from personality, for detecting difference in sensations?

Personality is the place at which both parties should expend their strength. Mr. Mill and Mr. Bain, understanding this, have sought to obliterate the distinction between feeling and self-consciousness. They have maintained the priority of an impersonal feeling. Here is the starting-point, not in personality, but in feeling. Personality is a development from impersonality by what Mr. Mill calls a "process of reference." This is one of those magical terms, like the newer word "functionate," which serve to obscure the failure of an undertaking. Mr. Bain also starts with a nervous system and feeling, and gives what may be taken as the latest expression of the movement toward unification of soul and body. He says: "The arguments for the two substances—mind and matter—have, we believe, entirely lost their validity; they are no longer compatible with ascertained science and clear thinking. One substance with two sets of attributes, two sides (a physical and a mental), a double-faced unity, would appear to comply with all the exigencies of the case." This assertion of a double-faced unity not only fails to bridge the chasm that is rationally impassable, not only increases the confusion by uniting contradictory

attributes in too small a compass, but it is a pure metaphysical or ontological predication, from which reason defend us! As to the existence of any Spinozistic substance holding in itself the irreconcilables thought and extension, how can it any longer be worth while to express an opinion? Perhaps matter is double-faced. This is a speculation which, as it transcends, contradicts experience.

If I mistake not, Mr. Mill and Mr. Bain have themselves refuted their position with regard to the development of personality from impersonal feeling. Mr. Mill ("Examination of Hamilton," page 242) says: "If, therefore, we speak of the mind as a series of feelings, we are obliged to complete the statement by calling it a series which is aware of itself as past and present; and we are reduced to the alternative of believing that the mind or ego is something different from any series of feelings or possibilities of them, or of accepting the paradox that something which, by hypothesis, is but a series of feelings, can be aware of itself as a series." In his edition of "The Analysis of the Human Mind" (i, 230) he further says, "There is no meaning in the word ego, or I, unless the I of to-day is also the I of yesterday." This must be taken as an admission that personality is an essential for personal identity.

Mr. Bain says: "We may be in a state of pleasure with *little* or nothing of thought" (personal consciousness) "accompanying. We are still properly said to be conscious or under consciousness. It is thus correct to draw a line between feeling and knowing that we feel, *although there is great delicacy in the operation.* [Italics are the writer's.] It may be said in one sense that we can not feel without knowing that we feel; but the assertion is verging on error, for a feeling may be accompanied with a *minimum* of cognitive energy or, *as good as*, none at all." I am unable to appreciate this passage as other than an abandonment of the development theory applied to personality. The language of Professor Calderwood seems just when he writes, "If in every sensation, every feeling, there is a particle of cognitive energy" (if the sensation be known as mine in any sense) "the development theory as an account of personality fails."

Under the influence of the *a priori* procedure, both metaphysical and theological, most of us flee with raised hands of horror at sound of the word will. Recollections of "you shall and you sha'n't, you can and you can't, you will and you won't," crowd round in ever-thickening confusion. Still, it must be said that, apart from all talk about freedom and bondage, volition is a decidedly large fact in human experience. Though Goethe is right in saying, "Ein kleiner Ring begränzt unser Leben," a ring of circumstance, of inheritance, yet within the circle of that ring a measure of action prevails which no word describes save the word willed. The action is determined by personality. It is impossible to find provision for this in the nervous system. Inhibitory nerves there may be, but the experience of our-

selves as using within fixed limits this physical organism is an experience too unique to come within nerve-actions and reactions before pleasure and pain.

There is no need to multiply illustrations of the exercise of will in holding muscles still against pain or of those higher manifestations where we endure agony, not from any present suffering, but to avoid future loss.

In conclusion, and for completeness, reference should be made to the moral consciousness, i. e., the knowledge of obligation. This, too, is a fact in human experience, and as such demands to be traced to its ultimates. A significant thing, from the philosophical side, is Mr. Spencer's anticipatory publication of the "Data of Ethics." By this publication Mr. Spencer has recognized, what many of his smaller adherents fail to know, that, in ethics, as an attempt to give a rational account of the consciousness of obligation, all thinking finds its highest and most serious application.

We discover in the nervous system no provision for the consciousness of duty; indeed, put in this bald way, no materialist would look there for any such consciousness. Duty as something to be done for its own sake, apart from creed, or sect, or party, or consequences, is properly considered an evidence of culture in thought and action. It is futile to attempt to resist the application of evolution to ethics by any appeal to the transcendent beauty of the moral ideal. The rose is a transcendent thing in color, fragrance, and outline; still, it develops from that which has none of these.

Development of some kind is a fact. The stress of inquiry in ethics is, I think, here: Can the sense of right and wrong, however rudimentary, be produced by pains and pleasures? In the nervous system we have the physical antecedents for pain and pleasure; though no such sensations are in the nervous system, they are in us. Ethics therefore presents the development theory a further difficulty, viz., the one of passing rationally from pains and pleasures to right and wrong. Even Mr. Spencer's form of the development theory, which would seek to find in the conduct called ethical but a part of conduct in general, and to regard all conduct, both ethical and non-ethical, as adjustments of means to ends; even this form of the theory must be able to make it plain that the transition from conduct non-ethical to conduct ethical is *gradual*, composed of many steps, and not, as experience seems to teach, sudden, distinct, and sharp.

What belief, then, does reason require in our present state of knowledge as to the relation between nerve-matter and consciousness? We distinguish two series, two kinds of experiences; these stand to one another as outward and inward, physical and spiritual, compound and simple. We do not know the nature of either. The terms matter and soul are our highest generalizations from experience. The materialist errs when he pronounces upon the character of matter, affirming that

in itself, as it lies beyond his vision, it is hard, round, inelastic, double-faced. The spiritualist errs when he pronounces upon the nature of spirit, as it lies beyond his ken, naming it, in essence, immortal, divine.

Unity there somehow is in this universe. There are no breaks if we could read aright. Perhaps this reading should see the beginning in the end, not the end in the beginning. The charcoal sketch of Angelo would indeed be promise and potency of greater things, and this because in it was more than charcoal. So it may be well, even rational, to interpret all things and all beings.

THE STATE *VERSUS* THE MAN:

A CRITICISM OF MR. HERBERT SPENCER.

By ÉMILE DE LAVELEYE.

"La nature est l'injustice même."—RENAN.

FOUR articles of Mr. Herbert Spencer's, which appeared in the CONTEMPORARY REVIEW, have recently been reprinted together, and form now a work which Mr. Spencer has entitled "The Man *versus* The State." This little volume merits the most attentive study, because in it the great sociological question of our day is treated in the most masterly manner. The individualist theory was, I think, never expounded better or with stronger arguments based on first principles, or supported by so great a number of clearly analyzed and admirably grouped facts. These pages are also full of important truths and of lessons, from whence both nations and governments may derive great benefit. Mr. Spencer's deductions are so concise and forcible that one feels oneself drawn, against one's will, to accept his conclusions; and yet, the more I have thought on the subject, the more convinced have I become that these conclusions are not in the true interest of humanity. Mr. Herbert Spencer's object is to prove the error and danger of State socialism, or, in other words, the error and danger of that system which consists in appropriating State, or communal, revenues to the purpose of establishing greater equality among men.

The eminent philosopher's statement, that in most civilized countries governments are more and more adopting this course, is indisputable. In England Parliament is taking the lead; in Germany Prince Bismarck, in spite of Parliament; and elsewhere either Parliament or town councils are doing the same thing. Mr. Spencer considers that this effort for the improvement of the condition of the working-classes, which is being everywhere made, with greater or less energy, is a violation of natural laws, which will not fail to bring its own punishment on nations, thus misguided by a blind philanthropy.

I believe, on the contrary, that this effort, taken as a whole, and setting aside certain mistaken measures, is not only in strict accordance with the spirit of Christianity, but is also in conformity with the true principles of politics and of political economy.

Let us first consider a preliminary question, on which I accept Mr. Spencer's views, but for different reasons from his: On what are individual rights founded, and what are the limits of State power? Mr. Spencer refutes with pitiless logic the opinions of those who, with Bentham, maintain that individual rights are State concessions, or who, like Matthew Arnold, deny the existence of natural rights. The absurdity of Bentham's system is palpably evident. Who creates the government? The people, says he. So the government, thus created, creates rights, and then, having created rights, it confers them on the separate members of the sovereign people, by which it was itself created. The real truth is, that government defines and sanctions rights, and employs the public strength to enforce their being respected, but the rights themselves existed before.

Referring to the history of all primitive civilization, Mr. Herbert Spencer proves to Mr. Matthew Arnold that in familial and tribal communities there existed certain customs, which conferred recognised and respected rights, before ever any superior authority which could be designated by the name of State had been formed. Only, I think Mr. Herbert Spencer is wrong in making use of the term "natural rights." This expression was an invention of the French philosophers of the eighteenth century, and it is still employed in Germany by a certain school of philosophers as *Naturrecht*. Sir Henry Maine's clever and just criticism of this expression in his book "Ancient Law" should warn us all of the vague and equivocal meaning it conceals. The jurists and philosophers of the seventeenth and eighteenth centuries attached two very different significations to the term "natural rights." They sometimes applied it to the condition of primitive societies, in which their optimism led them to dream of a reign of justice, liberty, and equality, and at other times they made use of it when speaking of the totality of rights which should be possessed by every individual, by reason of his manhood. These two conceptions are equally erroneous. In primitive societies, in spite of certain customs which are the embryo of rights, might reigns supreme, as among animals, and the best armed annihilate their weaker neighbours. Certainly, one would look in vain there for a model of a political constitution or code suitable to a civilized people. Neither can it be maintained that the "Rights of man," as proclaimed by the American and French Revolutions, belong to each individual, only because he forms part of the human species. The limit of rights which may be claimed by any one individual must depend upon his aptitudes for making good use of them. The same civil code and the same political institutions will not equally suit a savage tribe and a civilized nation. If

the granting of the suffrage to all were likely to lead a people to anarchy or to despotism, it could not be called a natural right, for suicide is not a right.

If one analyze completely the expression "natural rights," one finds that it is really not sense. Xavier de Maistre, annoyed by the constant appeals to nature which are to be found in all the writings of the eighteenth century, said, very wittily: "Nature, who and what is this woman?" Nature is subject to certain laws, which are invariable; as, for instance, the law of gravitation. We may call these "laws of nature," but in human institutions, which are ever varying, nothing of the sort can exist. This superior and ideal right, which is invoked for the purpose of condemning existing laws, and claiming their reform or suppression, should rather be called *rational right*—that is to say, right in conformity with reason.

In every country, and at all times, an order of things may be conceived—civil, political, penal and administrative laws—which would best conform to the general interest, and be the most favourable to the well-being and progress of the nation. This order of things is not the existing one. If it were, one might say, with the optimists, that all is for the best in the best of possible worlds, and a demand for any amelioration would be a rebellion against natural laws, and an absurdity. But this order of things may be caught sight of by reason, and defined with more or less accuracy by science; hence its name of rational order. If I ask for free trade in France, for a better division of property in England, and for greater liberty in Russia, I do so in the name of this rational order, as I believe that these changes would increase men's happiness.

This theory permits of our tracing a limit between individual liberty and State power.

Mr. Herbert Spencer proves very clearly that there are certain things which no man would ever choose to abandon to State power; his religious convictions, for instance. On the other hand, all would agree that the State should accept the charge of protecting frontiers and punishing theft and murder, that is to say, the maintaining of peace and security at home and abroad; only here, like most Englishmen, Mr. Herbert Spencer invokes human will. Find out, he says, on the one hand, what the great majority of mankind would choose to reserve to an individual sphere of action, and, on the other, what they would consent to abandon to State decisions, and you will then be able to fix the limit of the power of public authority.

I cannot myself admit that human will is the source of rights. Until quite recently, in all lands, slavery was considered a necessary and legitimate institution. But did this unanimous opinion make it any more a right? Certainly not. It is in direct opposition to the order of things which would be best for the general welfare; it cannot, therefore, be a right.

Until the sixteenth century, with the exception of a few Anabaptists who were burnt at the stake, all believed that the State ought to punish heretics and atheists. But this general opinion did not suffice to justify the intolerance then practised. The following line of argument, I think, would be most in keeping with individual interests, and, consequently, with the interests of society in general: A certain portion of men's acts ought not to be in any way subject to sovereign authority, be it republican or monarchical. But what is to be the boundary of this inviolable domain of individual activity? The will of the majority, or even of the entire population, is not competent to trace it, for history has proved but too often how gross have been the errors committed in such instances. This limit can, therefore, only be fixed by science, which, at each fresh progress in civilization, can discover and proclaim aloud where State power should cease to interfere. Sociological science, for instance, announces that liberty of conscience should always be respected as man's most sacred possession, and because religious advancement is only to be achieved at this price; that true property, or, in other words, the fruit of personal labour, must not be tampered with, or labour would be discouraged and production would diminish; that criminals must not go unpunished, but that justice must be strictly impartial, so that the innocent be not punished with the guilty.

It would not be at all impossible to draw up a formula of these essential rights, which M. Thiers called necessary liberties, and which are already inscribed in the constitutions of America, England, France, Belgium, Holland, and all other free nations. It it sometimes very difficult to know where to set bounds to individual liberty, in the interests of public order and of the well-being of others; and it is true, of course, that either the king, the assembly, or the people enacts the requisite laws, but if science has clearly demonstrated a given fact it imposes itself. When certain truths have been frequently and clearly explained, they come to be respected. The evidence of them forms the general opinion, and this engenders laws.

To be brief, I agree with Mr. Herbert Spencer that, contrary to Rousseau's doctrine, State power ought to be limited, and that a domain should be reserved to individual liberty which should be always respected; but the limits of this domain should be fixed, not by the people, but by reason and science, keeping in view what is best for the public welfare.

This brings me to the principal question I desire to treat. I am of opinion that the State should make use of its legitimate powers of action for the establishment of greater equality among men, in proportion to their personal merits, and I believe that this would be in conformity, not only with its mission properly speaking, but also with rational rights, with the progress of humanity; in a word, with all the rights and all the interests invoked by Mr. Herbert Spencer.

I will briefly resume the motives given by Mr. Herbert Spencer to show that any wish to improve the condition of the working-classes by law, or by the action of public power, so as to bring about a greater degree of equality among men, would be to run against the stream of history, and a violation of natural laws. There are, he says, two types of social organization, broadly distinguishable as the "militant" and the "industrial" type. The first of these is characterized by the *régime* of status, the second by the *régime* of contract. The latter has become general among modern nations, especially in England and America, whereas the militant type was almost universal formerly. These two types may be defined as the system of compulsory co-operation and the system of voluntary co-operation. The typical structure of the one may be seen in an army formed of conscripts, in which each unit must fulfil commands under pain of death, and receives, in exchange for his services, food and clothing; while the typical structure of the other may be seen in a body of workers who agree freely to exchange specified services at a given price, and who are at liberty to separate at will. So long as States are in constant war against each other, governments must perforce be on a military footing, as in antiquity. Personal defence, then, being society's great object, it must necessarily give absolute obedience to a chief, as in an army. It is absolutely impossible to unite the blessings of freedom and justice at home with the habitual commission of acts of violence and brutality abroad.

Thanks to the almost insensible progress of civilization and to gradual liberal reforms, the ancient militant State was little by little despoiled of its arbitrary powers, the circle of its interventions grew narrower and narrower, and men became free economically, as well as politically. We were advancing rapidly towards an industrial *régime* of free contract. But, recently, the Liberals in all countries have adopted an entirely opposite course. Instead of restricting the powers of the State, they are extending them, and this leads to socialism, the ideal of which is to give to government the direction of all social activity. Men imagine that, by thus acting, they are consulting the interests of the working-classes. They believe that a remedy may be found for the sufferings which result from the present order of things, and that it is the State's mission to discover and apply that remedy. By thus acting they simply increase the evils they would fain cure, and prepare the way for a universal bondage, which awaits us all—*the Coming Slavery*. Be the authority exercised by king, assembly, or people, I am none the less a slave if I am forced to obey in all things, and to give up to others the net produce of my labour. Contemporary progressism not only runs against the stream of history, by carrying us back to despotic organizations of the militant system, but it also violates natural laws, and thus prepares the degeneration of humanity. In family life the gratuitous parental aid must be great in proportion

as the young one is of little worth either to itself or to others, and benefits received must be inversely as the power or ability of the receiver.

"Throughout the rest of its life each adult gets benefit in proportion to merit, reward in proportion to desert, merit and desert being understood as ability to fulfil all the requirements of life. Placed in competition with members of its own species, and in antagonism with members of other species, it dwindles and gets killed off, or thrives and propagates, according as it is ill-endowed or well-endowed. If the benefits received by each individual were proportionate to its inferiority, if, as a consequence, multiplication of the inferior was furthered and multiplication of the superior hindered, progressive degradation would result, and eventually the degenerated species would fail to hold its ground in presence of antagonistic species and competing species." (Page 65.)

"The poverty of the incapable, the distress that comes upon the imprudent, the starvation of the idle, and the shouldering aside of the weak by the strong, which leave so many 'in shallows and in miseries,' are the decrees of a large, far-seeing benevolence." (Page 67.)

When the State, guided by a wrongly inspired philanthropy, prevents the application of this wise law, instead of diminishing suffering it increases it. "It tends to fill the world with those to whom life will bring most pain, and tends to keep out of it those to whom life will bring most pleasure. It inflicts positive misery, and prevents positive happiness." ("Social Statics," p. 381, edit. 1851.)

The law that Mr. Herbert Spencer desires society to adopt is simply Darwin's law—"the survival of the fittest." Mr. Spencer expresses his astonishment that at the present day, more than at any other period of the world's history, everything is done to favour the survival of the unfittest, when, at the same time, the truth as revealed by Darwin, is admitted and accepted by an ever-growing number of educated and influential people!

I have endeavoured to give a brief sketch of the line of argument followed by Mr. Herbert Spencer. We will now see what reply can be made to it. I think one chief point ought not to have escaped the eminent writer. It is this: If the application of the Darwinian law to the government of societies be really justifiable, is it not strange that public opinion, not only in England, but in all other countries, is so strenuously opposed to it, at an epoch which is becoming more and more enlightened, and when sociological studies are pursued with so much interest? If the intervention of public power for the improvement of the condition of the working-classes be a contradiction of history, and a return to ancient militant society, how is it that the country in which the new industrial organization is the most developed—that is to say, England—is also the country where State intervention is the most rapidly increasing, and where opinion is at the same time pressing for these powers of interference to be still further extended? There is no other land in which

the effort to succour outcasts and the needy poor occupies so large a portion of the time and means of the well-to-do and of the public exchequer; there is nowhere else to be found a poor-law which grants assistance to even able-bodied men; nowhere else would it ever have been even suggested to attack free contract, and consequently the very first principles of proprietorship, as the Irish Land Bill has done; and nowhere else would a Minister have dared to draw up a programme of reforms such as those announced by Mr. Chamberlain at the Liberal Reform Club at Ipswich (Jan. 14, 1885). On the Continent all this would be looked upon as rank socialism. If, then, as a country becomes more civilized and enlightened it shows more inclination to return to what Mr. Herbert Spencer calls militant organization, and to violate the Darwinian law applied to human society, may we not be led to conclude that this so-called retrogression is really progress? This conclusion would very easily explain what Mr. Herbert Spencer designates as the "wheeling round" of the Liberal party with which he so eloquently reproaches them.

Why did the Liberals formerly do their utmost to restrict State power? Because this power was then exercised in the interests of the upper classes and to the detriment of the lower. To mention but one example: When, in former times, it was desired to fix a scale of prices and wages, it was with a view to preventing their being raised, while, to-day, there is a clamour for a lessening of hours of labour with increased remuneration. Why do Liberals now wish to add to the power and authority of the State? To be able to ameliorate the intellectual, moral, and material condition of a greater number of citizens. There is no inconsistency in their programme; the object in view, which is the great aim of all civilization, has been always the same—to assure to each individual liberty and well-being in proportion to his merit and activity!

I think that the great fundamental error of Mr. Herbert Spencer's system, which is so generally accepted at the present day, consists in the belief that if State power were but sufficiently reduced to narrow it to the circle traced by orthodox economists, the Darwinian law and the survival of the fittest would naturally follow without difficulty. Mr. Spencer has simply borrowed from old-fashioned political economy, without submitting to the fire of his inexorable criticism, the superficial and false notion that, if the *laissez-faire* and free contract *régime* were proclaimed, the so-called natural laws would govern the social order. He forgets that all individual activity is accomplished under the empire of laws, which enact as to ownership, hereditary succession, mutual obligations, trade and industry, political institutions and administrations, besides a multitude of laws referring to material interests, banking organizations, money, credit, colonies, army, navy, railways, etc.

For natural laws, and especially the law of the survival of the fittest,

to become established, it would be necessary to annihilate the immense existing edifice of legislation, and to return to the wild state of society when primitive men lived, in all probability, much as do animals, with no possessions, no successions, no protection of the weak by the State.

Those who, with Mr. Spencer and Haeckel and other Conservative evolutionists, are anxious to see the law of the survival of the fittest and of natural selection adopted in human society, do not realize that the animal kingdom and social organization are two such totally different domains that the same law, applied to each, would produce wholly opposite effects. Mr. Herbert Spencer gives an admirable description of the manner in which natural selection is accomplished among animals :—

"Their carnivorous enemies not only remove from herbivorous herds individuals past their prime, but also weed out the sickly, the malformed, and the least fleet and powerful. By the aid of which purifying process, as well as by the fighting so universal in the pairing season, all vitiation of the race through the multiplication of its inferior samples is prevented, and the maintenance of a constitution completely adapted to surrounding conditions, and therefore most productive of happiness, is ensured."

This is the ideal order of things which, we are told, ought to prevail in human societies, but everything in our present organization (which economists, and even Mr. Spencer himself, admit, however, to be natural) is wholly opposed to any such conditions. An old and sickly lion captured a gazelle; his younger and stronger brother arrives, snatches away his prize, and lives to perpetuate the species; the old one dies in the struggle, or is starved to death. Such is the beneficent law of the "survival of the fittest." It was thus among barbarian tribes. But could such a law exist in our present social order? Certainly not! The rich man, feebly constituted and sickly, protected by the law, enjoys his wealth, marries and has offspring, and if an Apollo of herculean strength attempted to take from him his possessions, or his wife, he would be thrown into prison, and were he to attempt to practise the Darwinian law of selection, he would certainly run a fair risk of the gallows, for this law may be briefly expressed as follows: Room for the mighty, for might is right. It will be objected that in industrial societies the quality the most deserving of recompense, and which indeed receives the most frequent reward, is not the talent of killing one's fellow-man, but an aptitude for labour and producing. But at the present time is this really so? Stuart Mill says that from the top to the bottom of the social ladder remuneration lessens as the work accomplished increases. I admit that this statement may be somewhat exaggerated, but, I think, no one will deny that it contains a large amount of truth. Let us but cast our eyes around us, and we see everywhere those who do nothing living in ease and even opulence, while the workers who have the

hardest labour to perform, who toil from night to morning in mines, or unhealthy workshops, or on the sea in tempests, in constant danger of death, are paid, in exchange for all these hardships, a salary hardly sufficient for their means of subsistence, and which, just now, has become smaller and smaller, in consequence of the ever-recurring strikes, and the necessary closing of so many factories, mines, etc., owing to the long-continued depression of trade. What rapid fortunes have been made by stock-broking manœuvres, by trickeries in supplying goods, by sending unseaworthy vessels to sea to become the coffins of their crews! Do not such sights as these urge the partisans of progress to demand the State's interference in favour of the classes who receive so inadequate a payment for their labours?

The economists of the old school promised that, if the *laissez-faire* and free contract *régime* were proclaimed, justice would reign universally; but when people saw that these fine promises were not realized, they had recourse to public power for the obtaining of those results which the much-boasted "liberty" had not secured.

The system of accumulating wealth and hereditary succession alone would suffice to prevent the Darwinian law ever gaining a footing in civilized communities. Among animals, the survival of the fittest takes place quite naturally, because, as generations succeed each other, each one must create his own position according to his strength and abilities; and in this way the purifying process, which Mr. Herbert Spencer so extols, is effected. A similar system was generally prevalent among barbarians; but, at the present day, traces of it may be seen only in instances of "self-made men;" it disappears in their children, who, even if they inherit their parents' talents and capacities, are brought up, as a rule, in so much ease and luxury that the germs of such talents are destroyed. Their lot in life is assured to them, so why need they exert themselves? Thus they fail to cultivate the qualities and tastes they may have inherited from their parents, and they and their descendants become in all points inferior to their ancestors who secured to them, by labour and industry, the privileged position they hold. Hence the proverb, *A père économe fils prodigue* (To a thrifty father, a spendthrift son).

It follows, therefore, that those who wish to see the law of natural selection, by the transmission of hereditary aptitudes, established amongst us should begin by demanding the abolition of hereditary succession.

Among animals, the vitiation of the race through the multiplication of its inferior samples is prevented "by the fighting so universal in the pairing season." In the social order the accumulation and hereditary transmission of wealth effectually impede the process of perfecting the race. In Greece after the athletic sports, or in those fortunate and chimerical days of which the Troubadours sang, "the most beautiful was sometimes given as a prize to the most valiant;"

but, in our prosaic age, rank and fortune too often triumph over beauty, strength, and health. In the animal world, the destiny of each one is decided by its personal qualities. In society, a man attains a high position, or marries a beautiful woman, because he is of high birth, or wealthy, although he may be ugly, lazy, and extravagant. The permanent army and the navy would also have to be destroyed, before the Darwinian law could triumph. Conscription on the Continent and enlistment in England (to a less degree) condemn many of the strongest and most warlike men to enforced celibacy; and, as they are subjected to exceptional dangers in the way of hazardous expeditions and wars, the death-rate is far higher amongst them than it would be under ordinary circumstances. In pre-historic times, or in a general way, such men would certainly have begotten offspring, as being the strongest and most apt to survive; in our societies, they are decimated or condemned to celibacy.

Having borrowed from orthodox political economy the notion that it would suffice to put a check on inopportune State intervention for the reign of justice to become established, Mr. Herbert Spencer proceeds to demonstrate that the legislators who enacted the poor-law, and all recent and present law-makers "who have made regulations which have brought into being a permanent body of tramps, who ramble from union to union, and which maintain a constant supply of felons by sending back convicts into society under such conditions that they are almost compelled again to commit crimes," are alone responsible for the sufferings of the working-classes. But may we not blame law-makers, or, rather, our own social order, for measures more fatal in their results than either of these—for instance, the law which concentrates all property into the hands of a few owners? Some years ago, Mr. Herbert Spencer wrote some lines on this subject which are the most severe indictment against the present social order that has ever fallen from the pen of a really competent writer:—

"Given a race of beings having like claims to pursue the objects of their desires—given a world adapted to the gratification of those desires—a world into which such beings are similarly born, and it unavoidably follows that they have equal rights to the use of this world. For if each of them 'has freedom to do all that he wills, provided he infringes not the equal freedom of any other,' then each of them is free to use the earth for the satisfaction of his wants, provided he allows all others the same liberty. And, conversely, it is manifest that no one or part of them may use the earth in such a way as to prevent the rest from similarly using it, seeing that to do this is to assume greater freedom than the rest, and, consequently, to break the law. Equity, therefore, does not permit property in land. On examination, all existing titles to such property turn out to be invalid; those founded on reclamation inclusive. It appears that not even an equal apportionment of the earth amongst its inhabitants could generate a legitimate proprietorship. We find that, if pushed to its ultimate consequences, a claim to exclusive possession of the soil involves a land-owning despotism. We

further find that such a claim is constantly denied by the enactments of our legislature. And we find, lastly, that the theory of the co-heirship of all men to the soil is consistent with the highest civilization; and that, however difficult it may be to embody that theory in fact, equity sternly commands it to be done." "By-and-by, men may learn that to deprive others of their rights to the use of the earth is to commit a crime inferior only in wickedness to the crime of taking away their lives or personal liberties." ("Social Statics," chap. ix.)

Has Mr. Herbert Spencer changed his opinions as to the proprietorship of the soil since these lines were written? Not at all, for, in the chapter entitled "The Coming Slavery," he writes that "the movement for land-nationalization is aiming at a system of land-tenure equitable in the abstract." But if society, in depriving numbers of persons of their right of co-heirship of the soil, has "committed a crime inferior only in wickedness to the crime of taking away their lives or personal liberties," ought it not, in common justice, to endeavour to repair the injury done? The help given by public assistance compensates very feebly for the advantages they are deprived of. In his important book, "La Propriété Sociale," M. Alfred Fouillée, examining the question from another standpoint, very accurately calls this assistance "la justice reparative." The numerous and admirable charitable organizations which exist in England, the keen emotion and deep commiseration manifested when the little pamphlet, "The Bitter Cry of Outcast London," was first published, the growing pre-occupation of Government with the condition of the working-classes, must be attributed, in the first instance certainly to Christian feeling, but also, in a great measure, to a clearer perception of certain ill-defined rights possessed by those who have been kept deprived of national or rather communal co-heirship. Mr. Herbert Spencer has expressed this idea so clearly and eloquently that I hope I may be allowed to quote the passage:—

"We must not overlook the fact that, erroneous as are these poor-law and communist theories, these assertions of a man's right to maintenance and of his right to have work provided for him, they are nevertheless nearly related to a truth. They are unsuccessful efforts to express the fact that whoso is born on this planet of ours thereby obtains some interest in it—may not be summarily dismissed again—may not have his existence ignored by those in possession. In other words, they are attempts to embody that thought which finds its legitimate utterance in the law: All men have equal rights to the use of the earth. . . . After getting from under the grosser injustice of slavery, men could not help beginning in course of time to feel what a monstrous thing it was that nine people out of ten should live in the world on sufferance, not having even standing room save by allowance of those who claim the earth's surface." ("Social Statics," p. 345.)

When one reads through that substantial essay, "The Man *versus* The State," it appears as if the principal or, indeed, the sole aim of State socialism were the extension of public assistance and increased

succour for the unworthy, whereas the reality is quite the reverse of this! Scientific socialism seeks, first of all, the means of so raising the working-classes that they may be better able to maintain themselves and, consequently, to dispense with the help of others; and, secondly, it seeks to find what laws are the most in conformity with absolute justice, and with that admirable precept, "Benefit in proportion to merit, reward in proportion to desert." In the speech delivered by Mr. Shaw Lefevre, last year (1884), as President of the Congress of Social Science, at its opening meeting at Birmingham, he traced, in most striking language, all the good that State intervention had effected in England of late years: Greater justice enforced in the relations between man and man, children better educated and better prepared to become useful and self-supporting members of the community, the farmer better guaranteed against the exaggerated or unjust demands of the proprietor, greater facilities for saving offered, health ensured to future generations by the hours of labour being limited, the lives of miners further safeguarded, so that there are less frequent appeals to public assistance, and, as a practical result of this last measure, the mortality in mines fallen in the last three years to 22·1 per thousand, as compared to 27·2 per thousand during the ten previous years—a decrease of 20 per cent.! One fact is sufficient to show the great progress due to this State legislation: in an ever-increasing population, crime is rapidly and greatly diminishing.

Suppose that, through making better laws, men arrive gradually at the condition of the Norwegian peasantry, or at an organization similar to that existing in the agricultural cantons of Switzerland; that is to say, that each family living in the country has a plot of ground to cultivate and a house to live in: in this case every one is allowed to enjoy the full fruit of his labour, and receives reward in proportion to his activity and industry, which is certainly the very ideal of justice—*cuique suum*.

The true instinct of humanity has ever so understood social organization that property is the indispensable basis of the family, and a necessary condition of freedom. To prevent any one individual from being deprived of a share in the soil, which was in primitive ages considered to be the collective property of the tribe, it was subjected to periodical divisions; these, indeed, still take place in the Swiss Allmend, in some Scottish townships, in the greater part of Java, and in the Russian Mir.

If such a *régime* as this were established, there would be no more "tramps wandering from union to union." In such a state of society as this, not in such as ours, the supreme law which ought to govern all economic relations might be realized. Mr. Herbert Spencer admirably defines this law in the following passage:—

"I suppose a dictum on which the current creed and the creed of science are at one may be considered to have as high an authority as can be found. Well,

the command, *If any would not work, neither should he eat*, is simply a Christian enunciation of that universal law of nature under which life has reached its present height, the law that a creature not energetic enough to maintain itself must die; the sole difference being, that the law which in one case is to be artificially enforced is in the other case a natural necessity."

This passage ought to be transcribed at the commencement of every treatise on social science as the supreme aim of all sociological research; only the delusion, borrowed from the old political economy, which consists in the belief that this dictum of science and Christianity is in practice in our midst, ought to be suppressed.

Is it not a fact that, everywhere, those who can prove by authentic documents that, for centuries past, their ancestors have thriven in idleness are the richest, the most powerful, the most sought after? Only at some future date will this dictum of science and Christianity be brought to bear on our social organization, and our descendants will then establish an order of things which will create economic responsibility, and ensure to each the integral enjoyment of the produce of his labour. The difficult but necessary work of sociology is to endeavour to discover what this organization should be, and to prepare its advent. Mr. Shaw Lefevre's speech shows very clearly the road that ought to be taken.

Mr. Herbert Spencer thinks, however, that this road would lead us directly to a condition of universal slavery. The State would gradually monopolize all industrial enterprises, beginning with the railways and telegraphs as it has already done in Germany and Belgium, then some other industries as in France, then mines, and finally, after the nationalization of land, it would also take up agricultural enterprise. The freedom enjoyed by a citizen must be measured, he says, not by the nature of the government under which he lives, but by the small number of laws to which he is subject. The essential characteristic of the slave is that he is forced to work for another's benefit. The degree of his slavery varies according to the greater or smaller extent to which effort is compulsorily expended for the benefit of another, instead of for self-benefit; in the *régime* which is approaching, man will have to work for the State, and to give up to it the largest portion of his produce. What matters it that the master under whose command he labours is not an individual, but society? Thus argues Mr. Herbert Spencer.

In my opinion, the State will never arrive at a monopoly of all industries, for the very simple reason that such a system would never answer. It is possible that some day a social organization such as M. Albert Schäffle, formerly Finance Minister in Austria, has explained, may grow up, in which all branches of production are placed in the hands of co-operative societies. But, be that as it may, men would be no more slaves in workshops belonging to the State than in those of merchants or manufacturers of the present day. Mr. Herbert Spencer

can very easily assure himself of this fact. Let him visit the State collieries at Saarbruck, or inspect the Belgian railways, and interrogate all the officials and workmen employed; he will find that, from the highest to the lowest, they are quite as free, quite as contented with their lot, as those engaged in any private industry. There is even far more guarantee against arbitrary measures, so that their real freedom is greater than elsewhere. The proof of this is the fact that posts in any industries belonging to the State are always sought for by the best workmen. If the degree of man's slavery varies according to the ratio between that which he is forced to yield up and that which he is allowed to retain, then it must be admitted that the majority of workmen and small farmers are certainly slaves now, for they have very little or no property, and, as their condition almost entirely depends on the hard law of competition, they can only retain for themselves the mere necessaries of life! Are the Italian *contadini*, whose sad lot I depicted in my "Lettres d'Italie," free? They are reduced to live entirely on bad maize, which subjects them to that terrible scourge, the *pellagra*. What sad truth is contained in their reply to the Minister who advised them not to emigrate!—

"What do you mean by the nation? Do you refer to the most miserable of the inhabitants of the land? If so, we are indeed the nation. Look at our pale and emaciated faces, our bodies worn out with over-fatigue and insufficient food. We sow and reap corn, but never taste white bread; we cultivate the vine, but a drop of wine never touches our lips. We raise cattle, but never eat meat; we are covered with rags, we live in wretched hovels; in winter we suffer from the cold, and both winter and summer from the pangs of hunger. Can a land which does not provide its inhabitants, who are willing to work, with sufficient to live upon, be considered by them as a fatherland?"

The Flemish agricultural labourer, who earns less than a shilling a day, and the small farmer, whose rack-rent absorbs the entire net profits; the Highland crofters, who have been deprived of the communal land, the sacred inheritance of primitive times, where they could at least raise a few head of cattle; the Egyptian fellahs, whose very life-blood is drained by European creditors—in a word, all the wretched beings all over the world where the soil is owned by non-workers, and who labour for insufficient remuneration; can they, any of them, be called free? It is just possible that, if the State were to become the universal industry director (which, in my opinion, is an impossible hypothesis), their condition would not be improved; but at all events it could not be worse than it is now.

I do not believe that "liberty must be surrendered in proportion as the material welfare is cared for." On the contrary, a certain degree of well-being is a necessary condition of liberty. It is a mockery to call a man free who, by labour, cannot secure to himself the necessaries of existence, or to whom labour is impossible because he possesses nothing of his own, and no one will employ him!

Compare the life of the soldier with that of the hired workman either in a mine or a factory. The first is the type of the serf in "The Coming Slavery," and the second the type of the independent man in an industrial organization under the free contract *régime*. Which of the two possesses the most real liberty? The soldier, when his daily duties are accomplished, may read, walk, or enjoy himself in accordance with his tastes; the workman, when he returns home worn out with fatigue after eleven or twelve hours' hard labour, too often finds no other recreation than the gin-palace. The labourer at his task must always, and all day long, obey the foreman or overseer, whether he be employed by a private individual, by the State, or by a co-operative society.

"Hitherto," says Mr. Herbert Spencer, "you have been free to spend your earnings in any way which pleases you; hereafter you shall not be free to spend it, but it will be spent for the general benefit." The important point, he adds, is the amount taken from me, not the hand that takes it. But if what is taken from my revenue is employed to make a public park which I am free to enter whenever I feel inclined, to build public baths where I may bathe in summer or winter, to open libraries for my recreation and instruction, clubs where I may spend my evenings, and schools where my children may receive an education which will enable them to make their own way in the world; to build healthy houses, let at a low rent, which save me the cruel necessity of living in slums, where the soul and the body are alike degraded; if all this be done, would the result be the same as if this sum were taken by some private Crœsus to spend on his personal pleasures and caprices? In the course of last summer, while in Switzerland and Baden, I visited several villages where each family is supplied, from forests belonging to the commune, with wood for building purposes and for fuel; also with pasturage for their cattle, and with a small plot of ground on which to grow potatoes, fruit, and vegetables. In addition to this, the wages of all public servants are paid for from the communal revenue, so that there is no local taxation whatever.* Suppose that these woods and meadows, and this land,

* I may mention as an example, the township of Freudenstadt, at the foot of the Kniebis, in Baden. Not a single farthing of taxation has been paid since its foundation in 1557. The commune possesses about 5,000 acres of pine-forest and meadow-land, worth about £10,000 sterling. The 1,420 inhabitants have each as much wood for their building purposes and firing as they wish for, and each one can send out to pasture, during the summer, his cattle, which he feeds during the winter months. The schools, church, thoroughfares, and fountains are all well cared for, and every year considerable improvements are made. 100,000 marks were employed in 1883 for the establishment in the village, of a distribution of water, with iron pipes. A hospital has been built, and a pavilion in the market-place, where a band plays on fête-days. Each year a distribution of the surplus revenue is made amongst the families, and they each obtain from 50 to 60 marks, or shillings, and more still when an extraordinary quantity of timber has been sold. In 1882, 80,000 marks were distributed amongst the 1,420 villagers. What a favoured country, is it not?

all belonged to a landed proprietor, instead of to the commune; he would go and lavish the revenue in large capitals or in travelling. What an immense difference this would make to the inhabitants! To appreciate this, it suffices merely to compare the condition of the Highland crofters, the free citizens of one of the richest countries in the world, and whose race has ever been laborious, with that of the population of these villages, hidden away in the Alpine cantons of Switzerland or in the gorges of the Black Forest. If, in the Highland villages of Scotland, rentals had been, as in these happy communes of Switzerland and Baden, partly reserved for the inhabitants, and partly employed in objects of general utility, how very different would have been the lot of these poor people! Had they but been allowed to keep for themselves the sea-weed and the kelp which the sea brings them, how far better off would they have been than they now are, as is admirably proved in Mr. Blackie's interesting book, "The Scottish Highlanders."

A similar remark may also be applied to politics. What matters it, says Mr. Herbert Spencer, that I myself contribute to make laws if these laws deprive me of my liberty? He mentions ancient Greece as an example to startle us at the notion of our coming state of slavery. He writes: "In ancient Greece the accepted principle was, that the citizen belonged neither to himself nor to his family, but to his city—the city being, with the Greek, equivalent to the community. And this doctrine, proper to a state of constant warfare, is one which socialism unawares re-introduces into a state intended to be purely industrial." It is perfectly certain that the *régime* of ancient Greek cities, which was founded on slavery, cannot be suitable to modern society, which is based on a system of labour. But we must not allow ourselves to forget what Greece was, nor all we owe to that Greek civilization, which, Mr. Herbert Spencer says, the "coming slavery" threatens to re-introduce amongst us. Not only philosophy, literature, and arts flourished as they have never done in any other age, but the political system so stamped characters with individuality that the illustrious men of Greece are types of human greatness, whose deeds and sayings will be engraven on the memory of men so long as the world lasts. If the "coming slavery" gives us such men as Pisistratus, Plato, Aristotle, Xenophon, Lycurgus, Sophocles, Thucydides, Epaminondas, Aristides, or Pericles, we shall, I think, have no cause to complain! But how is it that Greece produced such a bevy of great men? By her democratic institutions, combined with a marvellous system of education, which developed simultaneously the faculties of the mind and the body.

The German army, in spite of its iron discipline, arrives at results somewhat similar, though in a less degree. A rough peasant joins a regiment; he is taught to walk properly, to swim, and to shift for himself; his education is made more complete, and he becomes a man

of independent character, better fitted to survive in the struggle for life. If the authorities in towns levy heavy taxes, and employ the money in improving the condition of the inhabitants and in forming those who need forming, even more than in the German army, and after the fashion of the ancient Greeks, will not the generations yet to come be better able to earn their own livelihood, and to maintain an honourable position, than if they had been allowed to pass their childhood in the gutters? Mr. Herbert Spencer reasons falsely when he says, "What matters it that I make the laws if these laws deprive me of my liberty?" Laws which tax me to degrade and rob me are odious, but laws which deprive me of what I have for my own good and for the further development of my faculties are well-meaning, as is the constraint imposed on his children by a wise father for their instruction or correction. Besides, to contribute to make laws elevates a man's character. As Stuart Mill has proved, this is indeed one of the great advantages of an extension of the suffrage. A man called upon to vote is naturally raised from the sphere of personal to that of general interests. He will read, discuss, and endeavour to obtain information. Others will argue with him, try to change his opinions, and he will himself realize that he has a certain importance of his own, that he has a word to say in the direction of public affairs. The elevating influence of this sentiment over French, and still more over Swiss, citizens is remarkable.

It is perfectly true that, for political and social reforms to be productive of fruits, the society into which they are introduced must be in a sufficiently advanced condition to be able to understand and apply them, but it must not be forgotten that improved institutions make better men.

Go to Norway; crimes are hardly known there. In the country people never close their doors at night, locks and bolts are scarcely known, and there are no robberies; probably, first, because the people are moral and religious, but certainly, also, because property is very equally divided. None live in opulence and none in absolute beggary, and certainly misery and degradation, which often results from misery, are the causes of the great majority of crimes.

The rich financier, Helvetius, wrote, very truly, that, if every citizen were an owner of property, the general tone of the nation would be conservative, but if the majority have nothing, robbery then becomes the general aim. ("De l'Homme," sect. vi. chap. vii.)

In conclusion, let us try to go to the root of the matter. Two systems are suggested as cures for the evils under which society is suffering. On the one hand, it may be said, in accordance with the doctrines of Christianity and socialism, that these evils are the consequences of men's perversity and selfishness, and that it behoves charity and fraternity to remedy them. We must do our best to assist our unfortunate brethren. But how? By trying, Christ tells us, to imi-

tate God's Kingdom, where "the last shall be first and the first last;" —or by "having all things in common," say the Apostles in all the ardour of primitive Christianity, and later on certain religious communities;—or by the giving of alms and other charitable acts, says the Christianity of the middle ages;—while socialism maintains that this may be effected by reforms in the laws regulating the division of property. On the other hand, political economy and evolutionary sociology teach us that these miseries are the inevitable and beneficent consequences of natural laws; that these laws, being necessary conditions of progress, any endeavour to do away with them would be to disturb the order of nature and delay the dawn of better things. By "the weeding out of the sickly and infirm," and the survival of the fittest, the process of amelioration of species in the animal kingdom is accomplished. This law of natural selection should be allowed free and ample scope in human society. "Society is not a manufacture, but a growth." Might is really right, for it is to the general interest that the mighty should triumph and perpetuate the race. Thus argues what is now called *Science*.

In a book entitled "The True History of Joshua Davidson," the author places ideal Christianity and contemporary society face to face, and shows very clearly the opposition which exists between the doctrines of would-be science and those of the Gospel:—

"If the dogmas of political economy are really exact, if the laws of the struggle for life and the survival of the fittest must really be applied to human society, as well as to plants and animals, then let us at once admit that Christianity, which gives assistance to the poor and needy, and which stretches out a hand to the sinner, is a mere folly; and let us at once abandon a belief which influences neither our political institutions nor our social arrangements, and which *ought* not to influence them. If Christ was right, then our present Christianity is wrong, and if sociology really contains scientific truth, then Jesus of Nazareth spoke and acted in vain, or rather He rebelled against the immutable laws of nature." (Tauchnitz edition, p. 252.)

Mr. William Graham, in his "Creed of Science" (p. 278), writes as follows:—

"This great and far-reaching controversy, the most important in the history of our species, which is probably as old as human society itself, and certainly as old as the 'Republic' of Plato, in which it is discussed, or as Christianity, which began with a communistic form of society, had yet only within the past half century come to be felt as a controversy involving real and living issues of a momentous character, and not utopias only remotely bordering upon the possible."

I think it may be proved that this so-called "doctrine of science" is contrary to facts, and is, consequently, not scientific; whereas the creed of Christianity is in keeping with both present facts and ideal humanity.

Darwin borrowed his idea of the struggle for existence and the

survival of the fittest from Malthus, from whom he also drew his theories of evolution and of transformism; but no naturalist ever dreamt of applying either of these laws to human society. It has been reserved to sociology to attempt this, because it has accepted, blindfolded, from the hands of economists, this most erroneous principle: that society is governed by natural laws, and that it suffices to give them free scope for the greatest possible happiness and prosperity to reign. It is manifestly true that, as human society is comprehended in what we call Nature, it must obey her laws; but the laws and institutions, in all their different forms, which decree as to the acquisition and transmission of property or possessions, and hereditary succession, in a word, all civil and penal laws, emanate from men's will, and from the decisions of legislators; and if experience, or a higher conception of justice, shows us that these laws are bad, or in any way lacking, we are free to change them. As far as the Darwinian laws are concerned, it would be perfectly impossible to apply them to existing society without more radically destroying all established institutions than the most avowed Nihilist would wish to do.

If it be really advisable that the law of the "survival of the fittest" should be established amongst us, the first step to be taken would be the abolition of all laws which punish theft and murder. Animals provide themselves with food by physical activity and the use of their muscles. Among men, in consequence of successive institutions, such as slavery, servitude, and revenue, numbers of people now live in plenty on their income, and do nothing at all. If Mr. Herbert Spencer is really desirous to see the supreme principle, "reward in proportion to desert," in force amongst us, he must obtain, first of all, the suppression of the existing regulations as to property. In the animal world, the destiny of each is decided by its aptitudes. Among ourselves, the destiny of each is determined by the advantages obtained or inherited from parents, and the heir to, or owner of, a large estate is sure to be well received everywhere. We see then, that before Darwinian laws can become established, family succession must be abolished. Animals, like plants, obey the instincts of nature, and reproduce themselves rapidly; but incessant carnage prevents their too excessive multiplication! As men become more civilized, peace becomes more general; they talk of their fellow-men as their brothers, and some philosophers even dream—the madmen!—of arbitration supplanting war! The equilibrium between the births and the deaths is thus upset! To balance it again, let us glorify battles, and exclaim, with General Moltke, that the idea of suppressing them is a mischievous utopia; let us impose silence on those dangerous fanatics who repeat incessantly, "Peace on earth, good will towards men."

In the very heart of nature reigns seeming injustice; or, as M. Renan puts it more strongly, nature is the embodiment of injustice.

A falling stone crushes both the honest man and the scamp! A bird goes out to find food for its young, and after long search is returning to its nest with its well-earned gains, when an eagle, the despot of the air, swoops down and steals the food; we think this iniquitous and odious, and would not tolerate such an instance amongst us. Vigorous Cain kills gentle Abel. Right and justice protest. They should not do so, for it is the mere putting in practice "of the purifying process by which nature weeds out the least powerful and prevents the vitiation of the race by the multiplication of its inferior samples." Helvetius admirably defines, for its condemnation, this Darwinian law which Herbert Spencer would have society accept:—

"The savage says to those who are weaker than himself: Look up to the skies and you see the eagle swooping down on the dove; cast your eyes on the earth and you see the lion tearing to pieces the stag or the antelope; while in the depths of the ocean small fishes are destroyed by sharks. The whole of nature announces that the weak must be the prey of the strong. Strength is a gift of the gods. Through it I become possessor of all it is in my power to capture." ("De l'Homme," iv. 8.)

The constant effort of moralists and legislators has been to replace the reign of might by a reign of justice. As Bacon says, *In societate aut vis aut lex viget.* The object is to subject men's actions more and more to the empire of the law, and that the law should be more and more in conformity with equity. Society has ever been, and still is, to a great extent, too much a reflection of nature. Violations of justice are numerous, and, if these are to be put a stop to, we must oppose ourselves still more to the laws of nature, instead of contemplating their re-establishment.

This is why Christianity, which is an ardent aspiration after justice, is in real accordance with true science. In the book of Job the problem is tragically proposed. The unjust are equally happy with the just, and, as in nature, the strong live at the cost of the weak. Right protests against this, and the voice of the poor is raised against their oppressors. Listen. What deep thought is contained in the following passage!—"Wherefore do the wicked live, become old, yea, are mighty in power? Their seed is established in their sight with them, and their offspring before their eyes. Their houses are safe from fear, neither is the rod of God upon them" (Job xxi. 7–9). "Some remove land-marks; they violently take away flocks and feed thereof. They cause him to go naked without clothing, and they take away the sheaf from the hungry; which make oil within their walls, and tread their wine-presses, and suffer thirst" (Job xxiv. 2, 10, 11).

The prophets of Israel raised an eloquent protest against the evils then reigning in society, and announced that a time should come when justice would be established upon the earth. These hopes of a Messiah were expressed in such precise terms that they may serve as a

programme of the reforms which yet remain to be accomplished. "He shall judge the poor of the people, He shall save the children of the needy, and shall break in pieces the oppressor. He shall spare the poor and needy, and shall save the souls of the needy. There shall be an handful of corn in the earth upon the top of the mountains" (Psalm lxxii. 4, 13, 16). "And the work of righteousness shall be peace; and the effect of righteousness, quietness and assurance for ever" (Isaiah xxxii. 17). "Surely I will no more give thy corn to be meat for thine enemies, and the sons of the stranger shall not drink thy wine, for the which thou hast laboured; but they that have gathered it shall eat it, and praise the Lord; and they that have brought it together shall drink it in the courts of My holiness" (Isaiah lxii. 8, 9). In the New Jerusalem "there shall be no more sorrow nor crying." "They shall not build, and another inhabit; they shall not plant, and another eat; for as the days of a tree are the days of My people, and Mine elect shall long enjoy the work of their hands" (Isaiah lxv. 21, 22).

The prophet thus raises his voice in favour of the poor, in the name of justice, not of charity and mercy. "The Lord will enter into judgment with the ancients of His people and the princes thereof: for ye have eaten up the vineyard; the spoil of the poor is in your houses. What mean ye that ye beat My people to pieces, and grind the faces of the poor? saith the Lord God of hosts" (Isaiah iii. 14, 15). "Woe unto them that join house to house, that lay field to field till there be no place, that they may be placed alone in the midst of the earth" (Isaiah v. 8). In the future society property will be ensured to all, and every one will "sit under his vine and under his fig-tree" (Micah iv. 4).

The ideal of the prophets comprehends, then, in the first place, the triumph of justice, which will bring liberty to the oppressed, consolation to the outcast, and the produce of their labours to the workers; and secondly, and chiefly, it will bring the glorification and domination of the elect people—Israel.

The ideal of the Gospel makes less of this second consideration of national grandeur and pre-eminence, and places in the foreground the radical transformation of the social order. The Gospel is the "good tidings of great joy," the Εὐαγγέλιον, carried to the poor, the approach of the Kingdom of God—that is to say, of the reign of justice. "The last shall be first;" therefore the pretended "natural order" will be reversed!

Who will possess the earth? Not the mightiest, as in the animal creation, and as Darwinian laws decree; not the rich, "for it is easier for a camel to go through a needle's eye than for a rich man to enter the Kingdom of God." Lazarus is received into Abraham's bosom, while Dives is cast into the place of torment, "where there is weeping and gnashing of teeth." The first of biological precepts,

the one respecting the survival of the fittest, as it immolates others for personal benefit, is essentially selfish, which is a vice incessantly reprobated in the New Testament. "Look not every man on his own things, but every man also on the things of others" (Philippians ii. 4). The chief of all Christian virtues is charity; it is the very essence of the Gospel. "Seek ye first the Kingdom of God and His righteousness, and all these things shall be added unto you" (St. Matthew vi. 33).

How very true is the economic doctrine that, with equitable laws, each should enjoy the integral produce of his labour, and that, were this the case, personal activity would attain its highest degree. Nothing is more adverse to the prosperity of a nation than unjust laws; and this is precisely what the prophets and Christ teach us.

If Darwinian laws were applied to human society, the utility of history, considered as a moral lesson for both kings and people, would be destroyed. The history of man might then be looked upon as a mere zoölogical strife between nations, and a simple lengthening out of natural history. What moral instruction can possibly be drawn from the study of the animal world, where the strong devour or destroy the weak? No spectacle could be more odious or more demoralizing!

The incomparable sublimity of the Gospel, which is, alas! only too often misinterpreted, consists in an ardent longing for perfection, in that aspiration for an ideal of justice which urged Jesus and His earliest disciples to condemn the world as it then was. Thence sprang the hatred of evil in its many various forms, the desire for better things, for reforms and progress! Why do Mahometans stand still in the march of civilization, while Christian countries advance ever more and more rapidly? Because the first are resigned to evil, whereas the second combat and endeavour to extirpate it. The stoicism—the elevated character of which can hardly be sufficiently admired—the austerity, and purity of such ancients as Marcus Aurelius, nevertheless, bowed before absolute facts, looking upon them as the inevitable results of the actual and natural order of things. Like modern evolutionists, they glorified the laws of nature, considering them perfect. Their optimism led them so far as to adore the cosmos as a divinity. "All that thou wilt, O Cosmos," says Marcus Aurelius, "is my will; nothing is too early or too late for me, if it be at the hour thou decidest upon. My fruit is such as thy seasons bring, O Nature! From thee comes all. Thou art all. All go towards thee. If the gods be essentially good and just, they must have permitted nothing, in the arrangement of the world, contrary to right and justice." What a contrast between this serene satisfaction and the complaints of Job, of the prophets, and of Christ Himself! The true Christian, in direct opposition to stoics and to Mr. Herbert Spencer, holds that the world is completely infected with evil; he avoids it carefully, and lives in the hope of a general cataclysm, which will reduce our globe to ashes,

and make place for a new and purified heaven and earth! The belief of stoics and of evolutionary sociologists logically advocates inaction, for it respects the present order of things as attributable to natural laws. The Christian's belief leads him to ardently desire reform and progress, but also, when he is deceived and reduced to despair, it occasionally culminates in revolutionary violence and in Nihilism.

Not only Jesus, but all great religious reformers, such as Buddha, Mahomet, Luther, and the great philosophers, especially Socrates and Plato, and the great lawgivers, from Solon and Lycurgus to the legislators of the French Revolution—all the elect of humanity, in fact—are struck with the evils under which our race is forced to suffer, and have imagined and revealed an ideal social order more in conformity with the ideal of justice; and in their writings they place this Utopia in contrast with the existing order. The more Christianity becomes despoiled of dogmas, and the more the ideas of moral and social reform, contained in Christ's teachings, are brought forward as the chief aim, the more Mr. Herbert Spencer's principles will be shunned and avoided. In the splendid development of Roman law, which lasted fifteen hundred years, a similar evolution took place. In the beginning, in the laws of the twelve tables, many traces of the hard law in favour of the mighty may be found. This is symbolized by the lance (*quir*), which gave its name to the quiritarian right. The father was allowed to sell or destroy his children, as they were his possession. He had absolute power over his slaves, who were his "things." The creditor might throw his debtor in prison, or even cause him to be cut in pieces —*in partes secanto.* The wife was entirely in her husband's power—*in manu.* Little by little, as centuries rolled on, eminent lawgivers succeeded each other, and gradual changes were made, so that, finally, just and humanitarian principles penetrated the entire Roman code, and the Darwinian law, which glorifies might, gave place to the Christian law, which extols justice.

This movement will most assuredly continue, in spite of all the abuse it may receive from Mr. Herbert Spencer, and from others who think as he does. It is a result of the advance of civilization from the commencement of Christianity, and even from the time of the prophets of Israel. It will manifest itself, not as it did in the middle ages, by works of mercy, but, under the control of economic science, by the intervention of the State in favour of the disinherited, and by measures such as Mr. Shaw Lefevre approves of, so that each and all should be placed in a position to be able to command reward in proportion to the amount of useful labour accomplished.

Darwinian laws, generally admitted in the domain of natural history and in the animal kingdom, will never be applied to human societies, until the sentiments of charity and justice, which Christianity engraves on our hearts, are completely eradicated.—*Contemporary Review.*

A REJOINDER TO M. DE LAVELEYE.

By HERBERT SPENCER.

THE Editor of the CONTEMPORARY REVIEW having kindly allowed me to see a proof of the foregoing article by M. de Laveleye, and having assented to my request that I might be allowed to append a few explanations and comments, in place of a more formal reply in a future number of the Review, I have, in the following pages, set down as much as seems needful to prevent the grave misunderstandings likely to be produced by M. de Laveleye's criticisms, if they are permitted to pass unnoticed.

On the first page of his essay, M. de Laveleye, referring to the effort to establish "greater equality among men" by "appropriating State, or communal, revenues" for that end, writes—

> "Mr. Spencer considers that this effort for the improvement of the condition of the working-classes, which is being everywhere made with greater or less energy, is a violation of natural laws, which will not fail to bring its own punishment on nations, thus misguided by a blind philanthropy" (p. 485).

As this sentence stands, and especially as joined with all which follows, it is calculated to produce the impression that I am opposed to measures "for the improvement of the condition of the working-classes." This is quite untrue, as numerous passages from my books would show. Two questions are involved—What are the measures? and—What is the agency for carrying them out? In the first place, there are various measures conducive to "improvement of the condition of the working-classes" which I have always contended, and still contend, devolve on public agencies, general and local—above all, an efficient administration of justice, by which they benefit both directly and indirectly—an administration such as not simply represses violence and fraud, but promptly brings down a penalty on every one who trespasses against his neighbour, even by a nuisance. While contending for the diminution of State-action of the positively-regulative kind, I have contended for the increase of State-action of the negatively-regulative kind—that kind which restrains the activities of citizens within the limits imposed by the existence of other citizens who have like claims to carry on their activities. I have shown that "maladministration of justice raises, very considerably, the cost of living for all;" * and is, therefore, felt especially by the working-classes, whose state is most closely dependent on the cost of living. As one of the evils of over-legislation, I have, from the beginning, urged that, while multitudinous other questions absorb public attention, the justice-question gets scarcely any attention; and social life is everywhere

* "Study of Sociology," p. 415, postscript in library edition.

vitiated by the consequent inequities.* While defending *laissez-faire* in its original and proper sense, I have pointed out that the policy of universal meddling has for its concomitant that vicious *laissez-faire* which leaves dishonesty to flourish at the expense of honesty.† In the second place, there are numerous other measures conducive to "the improvement of the condition of the working-classes" which I desire quite as much as M. de Laveleye to see undertaken; and simply differ from him concerning the agency by which they shall be undertaken. Without wishing to restrain philanthropic action, but quite contrariwise, I have in various places argued that philanthropy will better achieve its ends by non-governmental means than by governmental means.‡ M. de Laveleye is much more familiar than I am with the facts showing that, in societies at large, the organized arrangements which carry on production and distribution have been evolved not only without State-help, but very generally in spite of State-hindrance; and hence I am surprised that he apparently gives no credence to the doctrine that, by private persons acting either individually or in combination, there may be better achieved multitudinous ends which it is the fashion to invoke State-agency for.

Speaking of the domain of individual liberty, M. de Laveleye says—

> "To be brief, I agree with Mr. Herbert Spencer that, contrary to Rousseau's doctrine, State power ought to be limited, and that a domain should be reserved to individual liberty which should be always respected; but the limits of this domain should be fixed, not by the people, but by reason and science, keeping in view what is best for the public welfare" (p. 488).

I am a good deal perplexed at finding the last clause of this sentence apparently addressed to me as though in opposition. "Social Statics" is a work mainly occupied with the endeavour to establish these limits by "reason and science." In the "Data of Ethics," I have sought, in a chapter entitled the "Sociological View," to show how certain limits to individual liberty are deducible from the laws of life as carried on under social conditions. And in "The Man *versus* The State," which M. de Laveleye is more particularly dealing with, one part of the last chapter is devoted to showing, deductively, the derivation of what are called "natural rights" from the vital needs, which each man has to satisfy by activities pursued in presence of other men who have to satisfy like needs; while another part of the chapter is devoted to showing, inductively, how recognition of natural rights began, in the earliest social groups, to be initiated by those retaliations which trespasses called forth—retaliations ever tending to produce respect for the proper limits of action. If M. de Laveleye does not consider

* See "Social Statics: 'The Duty of the State.'" Also "Essays," vol. ii. pp. 94–8; vol. iii. p. 167.

† "Study of Sociology," pp. 351–3, cheap edition.

‡ "Social Statics: 'Poor Laws.'"

this to be an establishment of limits "by reason and science," what are the kinds of "reason and science" by which he expects to establish them?

On another page M. de Laveleye says—

"I am of opinion that the State should make use of its legitimate powers of action for the establishment of greater equality among men, in proportion to their personal merits" (p. 489).

Merely observing that the expression "its legitimate powers of action" seems to imply a begging of the question, since the chief point in dispute is—What are "its legitimate powers of action;" I go on to express my surprise at such a sentence coming from a distinguished political economist. M. de Laveleye refers to the "old-fashioned political economy," implying that he is one of those younger economists who dissent from its doctrine; but I was quite unprepared to find that his dissent went so far as tacitly to deny that in the average of cases a proportioning of rewards to personal merits naturally takes place under the free play of supply and demand. Still less, after all the exposures made of the miseries inflicted on men throughout the past by the blundering attempts of the State to adjust prices and wages, did I expect to see in a political economist such a revived confidence in the State as would commission it to adjust men's rewards "in proportion to their personal merit." I hear that there are some who contend that payment should be proportionate to the disagreeableness of the work done: the implication, I suppose, being that the knacker and the nightman should receive two or three guineas a day, while a physician's fee should be half-a-crown. But, with such a proportioning, I suspect that, as there would be no returns adequate to repay the cost and time and labor of preparation for the practice of medicine, physicians would quickly disappear; as would, indeed, all those required for the higher social functions. I do not suppose that M. de Laveleye contemplates a proportioning just of this kind. But if in face of all experience, past and present, he trusts officialism to judge of "personal merits," he is sanguine to a degree which surprises me.

One of the questions which M. de Laveleye asks is—

"If the intervention of public power for the improvement of the condition of the working-classes be a contradiction of history, and a return to ancient militant society, how is it that the country in which the new industrial organization is the most developed—that is to say, England—is also the country where State intervention is the most rapidly increasing, and where opinion is at the same time pressing for these powers of interference to be still further extended?" (p. 491).

Several questions are here raised besides the chief one. I have already pointed out that my objection is not to "intervention of public power for the improvement of the condition of the working-classes,"

but to interventions of certain kinds. The abolition of laws forbidding trade-combinations, and of laws forbidding the travelling of artisans, were surely measures which improved "the condition of the working-classes;" and these were measures which I should have been eager to join in obtaining. Similarly, at the present time I am desirous of seeing provided the easiest and most efficient remedies for sailors fraudulently betrayed into unseaworthy ships; and I heartily sympathize with those who denounce the continual encroachments of landowners—enclosures of commons and the turf-covered borders of lanes, &c. These, and kindred injustices to the working-classes, stretching far back, I am no less desirous to see remedied than is M. de Laveleye; provided always that due care is taken that other injustices are not committed in remedying them. Evidently, then, this expression of M. de Laveleye raises a false issue. Again, he says that I call this public intervention on behalf of the working-classes "a return to ancient militant society." This is quite a mistake. In ancient militant society the condition of the working-classes was very little cared for, and, indeed, scarcely thought of. My assertion was that the *coercive system* employed was like the coercive system employed in a militant society: the *ends* to which the systems are directed being quite different. But turning to the chief point in his question, I meet it by counter-questions—Why is it that the "new industrial organization" is best developed in England? and—Under what conditions was it developed? I need hardly point out to M. de Laveleye that the period during which industrial organization in England developed more rapidly and extensively than elsewhere, was a period during which the form of government was less coercive than elsewhere, and the individual less interfered with than elsewhere. And if now, led by the admirers of Continental bureaucracies, eager philanthropists are more rapidly extending State-administrations here than they are being extended abroad, it is obviously because there is great scope for the further extension of them here, while abroad there is little scope for the further extension of them.

In justification of coercive methods for "improving the condition of the working-classes," M. de Laveleye says:

> "One fact is sufficient to show the great progress due to this State legislation: in an ever-increasing population, crime is rapidly and greatly diminishing" (p. 496).

Now, without dwelling on the fact, shown in Mr. Pike's "History of Crime in England," that "violence and lawlessness" had increased during the war period which ended at Waterloo; and without dwelling on the fact that, after the recovery from prostration produced by war, there was a diminution of crime along with that great diminution of coercive legislation which characterized the long period of peace; I go on to remark that a primary condition to the correct drawing of

inferences is—other things equal. Does M. de Laveleye really think, when comparing the state of the last generation with that of the present, that other things are so equal that to the growth of State-administrations can be ascribed the decrease of crime? He ignores those two factors, far more important than all others, which have produced a social revolution—railways and free-trade: the last resulting from the abolition of governmental restraints after a long struggle, and the first effected by private enterprise carried out in spite of strenuous opposition for some time made in the Legislature. Beyond all question, the prosperity due to these factors has greatly ameliorated the condition of the working-classes, and by so doing has diminished crime; for undoubtedly, diminishing the difficulties of getting food, diminishes one of the temptations to crime. If M. de Laveleye refers to a more recent diminution, then, unless he denies the alleged relation between drunkenness and crime, he must admit that the temperance agitation, with its pledges, its "Bands of Hope," and its "Blue Ribbon League," has had a good deal to do with it.

Before passing to the chief question let me correct M. de Laveleye on some minor points. He says—

"I think that the great fundamental error of Mr. Herbert Spencer's system, which is so generally accepted at the present day, consists in the belief that if State power were but sufficiently reduced," &c.

Now I set against this a sentence not long since published by Mr. Frederic Harrison:

"Mr. Spencer has himself just published . . . . 'The Man *versus* The State,' to which he hardly expects to make a convert except here and there, and about which an unfriendly critic might say that it might be entitled 'Mr. Spencer against all England.'" (*Nineteenth Century*, vol. xvi. p. 366.)

The fear lest my arguments should prevail, which I presume prompted M. de Laveleye's article, is evidently ill-founded. I wish I saw reason to believe that his estimate is nearer to the truth than the opposite one.

On p. 490, M. de Laveleye writes—

"The law that Mr. Herbert Spencer desires society to adopt is simply Darwin's law—'the survival of the fittest.'"

Perhaps I may be excused for wishing here to prevent further confirmation of a current error. In his article, M. de Laveleye has quoted from "Social Statics" passages showing insistance on the benefits resulting from survival of the fittest among mankind, as well as among animals; though he ignores the fact that the work as a whole is an elaborate statement of the conditions under which, and limits within which, the natural process of elimination of the unfit should be allowed to operate. Here my immediate purpose is to correct the impression which his statement, as above worded, produces, by naming the dates:

"Social Statics" was published in 1851; Mr. Darwin's "Origin of Species" in 1859.

And now I pass to the main issue. In pursuance of his statement that I wish society to adopt the survival of the fittest as its guiding principle, M. de Laveleye goes on to describe what would be its action as applied to mankind. Here are his words:

"This is the ideal order of things which, we are told, ought to prevail in human societies, but everything in our present organization (which economists, and even Mr. Spencer himself, admit, however, to be natural) is wholly opposed to any such conditions. An old and sickly lion captured a gazelle; his younger and stronger brother arrives, snatches away his prize, and lives to perpetuate the species; the old one dies in the struggle, or is starved to death. Such is the beneficent law of the 'survival of the fittest.' It was thus among barbarian tribes. But could such a law exist in our present social order? Certainly not! The rich man, feebly constituted and sickly, protected by the law, enjoys his wealth, marries and has offspring, and if an Apollo of herculean strength attempted to take from him his possessions, or his wife, he would be thrown into prison, and were he to attempt to practise the Darwinian law of selection, he would certainly run a fair risk of the gallows" (p. 492).

Now though, on the next page, M. de Laveleye recognizes the fact that the survival of the fittest, as I construe it in its social applications, is the survival of the industrially superior and those who are fittest for the requirements of social life, yet, in the paragraph I have quoted, he implies that the view I hold would countenance violent methods of replacing the inferior by the superior. Unless he desires to suggest that I wish to see the principle operate among men as it operates among brutes, why did he write this paragraph? In the work before him, without referring to other works, he has abundant proof that, above all things, aggression of every kind is hateful to me; and he scarcely needs telling that from my earliest book, written more than a third of a century ago, down to the present time, I have urged the change of all laws which either inflict injustice or fail to remedy injustice, whether committed by one individual against another, or by class against class, or by people against people. Why, then, did M. de Laveleye make it seem that I would, if I could, establish a reign of injustice under its most brutal form? If there needs proof that in my view the struggle for existence as carried on in society, and the greater multiplication of those best fitted for the struggle, must be subject to rigorous limitations, I may quote as sufficient proof a passage from the "Data of Ethics:" premising that the word co-operation used in it, must be understood in its widest sense, as comprehending all those combined activities by which citizens carry on social life:

"The leading traits of a code under which complete living through voluntary co-operation [here antithetically opposed to compulsory co-operation, characterizing the militant type of society] is secured, may be simply stated. The fundamental requirement is that the life-sustaining actions of each shall sever-

ally bring him the amounts and kinds of advantage naturally achieved by them; and this implies, firstly, that he shall suffer no direct aggressions on his person or property, and, secondly, that he shall suffer no indirect aggressions by breach of contract. Observance of these negative conditions to voluntary co-operation having facilitated life to the greatest extent by exchange of services under agreement, life is to be further facilitated by exchange of services beyond agreement; the highest life being reached only when, besides helping to complete one another's lives by specified reciprocities of aid, men otherwise help to complete one another's lives" (p. 149).

This passage, indeed, raises in a convenient form the essential question. It will be observed that in it are specified two sets of conditions, by conforming to which men living together may achieve the greatest happiness. The first set of conditions is that which we comprehend under the general name *justice;* the second set of conditions is that which we comprehend under the general name *generosity.* The position of M. de Laveleye, and of the multitudes who think with him, is that the community, through its government, may rightly undertake both to administer justice and to practise generosity. On the other hand, I, and the few who think with me, contend that justice alone is to be administered by the community in its corporate capacity; and that the practice of generosity is to be left to private individuals, and voluntarily-formed combinations of individuals. Insuring each citizen's safety in person and property, as well as insuring him such returns for his services as his fellow-citizens agree to give, is a public affair; while affording him help, and giving him benefits beyond those he has earned, is a private affair. The reason for maintaining this distinction is that the last duty can not be undertaken by the State without breach of the first. The vital requirement to social life must be broken that a non-vital requirement may be fulfilled. Under a reign of absolute justice unqualified by generosity, a social life may be carried on, though not the highest social life; but a reign of generosity without any justice—a system under which those who work are not paid, so that those who have been idle or drunken may be saved from misery—is fatal; and any approach to it is injurious. That only can be a wholesome state in which conduct brings its natural results, good or evil, as the case may be; and it is the business of Government, acting on behalf of all, to see that each citizen shall not be defrauded of the good results, and that he shall not shoulder off the evil results on to others. If others, in their private capacities, are prompted by affection or pity to mitigate the evil results, by all means let them do so: no power can equitably prevent them from making efforts, or giving money, to diminish the sufferings of the unfortunate and the inferior; at the same time that no power can equitably coerce them into doing this.

If M. de Laveleye holds, as he appears to do, that enforcing the normal relations between conduct and consequences, right as it may

be in the abstract, is impracticable under existing social conditions, which are in many cases such that men get what they have neither earned nor otherwise equitably received, and in many cases such that they are prevented from earning anything; then my reply is, by all means, where this condition of things is due to unjust arrangements, let us rectify these arrangements as fast as we can. But let us not adopt the disastrous policy of establishing new injustices for the purpose of mitigating the mischiefs produced by old injustices.—*Contemporary Review.*

WHALES, PAST AND PRESENT.*

By Professor W. H. FLOWER, F. R. S.

FEW natural groups present so many remarkable illustrations of several of the most important general laws which appear to have determined the structure of animal bodies as that of the whales. We find the effects of the two opposing forces—that of heredity or conformation to ancestral characters, and that of adaptation to changed environment, whether brought about by the method of natural selection or otherwise—distinctly written in almost every part of their structure. Scarcely anywhere in the animal kingdom do we see so many cases of the persistence of rudimentary and apparently useless organs, those marvelous and suggestive phenomena which at one time seemed hopeless enigmas, causing despair to those who tried to unravel their meaning, but now eagerly welcomed as beacons of true light, casting illuminating beams upon the dark paths through which the organism has traveled on its way to reach the goal of its present condition of existence.

It is chiefly to these rudimentary organs of the Cetacea and to what we may learn from them that I propose to call your attention. In each case the question may well be asked, Are they survivals, remnants of a past condition, become useless owing to change of circumstances and environment; or are they incipient structures, beginnings of what may in future become functional and important parts of the economy?

The term "whale" is commonly but vaguely applied to all the larger and middle-sized Cetacea, and, though such smaller species as the dolphins and porpoises are not usually spoken of as whales, they may to all intents and purposes of zoölogical science be included in the term. Taken all together the *Cetacea* constitute a distinct and natural order of mammals, characterized by their aquatic mode of life and external fish-like form. The body is fusiform, passing anteriorly into the head without any distinct constriction or neck, and posteriorly tapering off grad-

* Abridged from a lecture delivered at the Royal Institution, London, May 25, 1883.

ually toward the extremity of the tail, which is provided with a pair of lateral pointed expansions of skin supported by dense fibrous tissue, called "flukes," forming together a horizontally placed, triangular propelling organ. The fore-limbs are reduced to the condition of flattened ovoid paddles, incased in a continuous integument, showing no external sign of division into arm, fore-arm, and hand, or of separate digits, and without any trace of nails. There are no vestiges of hind-limbs visible externally. The general surface of the body is smooth and glistening, and devoid of hair. In nearly all species a compressed median dorsal fin is present. The nostrils open separately or by a single crescentic valvular aperture, not at the extremity of the snout, but near the vertex.

Animals of the order *Cetacea* abound in all known seas, and some species are inhabitants of the larger rivers of South America and Asia. Their organization necessitates their life being passed entirely in the water, as on the land they are absolutely helpless; but they have to rise very frequently to the surface for the purpose of respiration. They are all predaceous, subsisting on living animal food of some kind. One genus alone (*Orca*) eats other warm-blooded animals, as seals and even members of its own order, both large and small. Some feed on fish, others on small floating crustacea, pteropods, and medusæ, while the staple food of many is constituted of the various species of Cephalopods. With some exceptions the Cetacea generally are timid, inoffensive animals, active in their movements, sociable and gregarious in their habits.

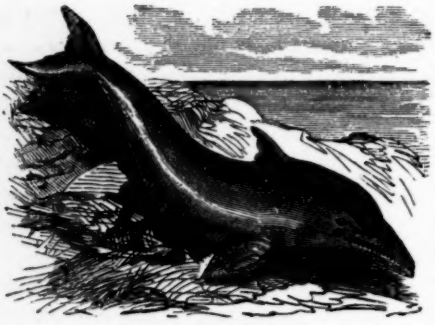

FIG. 1.—COMMON DOLPHIN.

Among the existing members of the order there are two very distinct types—the toothed whales, or *Odontoceti*, and the baleen (whalebone) whales, or *Mystacoceti*, which present throughout their organization most markedly distinct structural characters, and have in the existing state of nature no transitional forms.

The problem of the origin of the Cetacea and their relations to other forms of life is at present involved in the greatest obscurity. They present no more signs of affinity with any of the lower classes of vertebrated animals than do many of the members of their own class. Indeed, in all that essentially distinguishes a mammal from one of the oviparous vertebrates, they are as truly mammalian as any, even the highest, members of the class. Any supposed signs of inferiority are simply modifications in adaptation to their peculiar mode of life. In the present state of our knowledge, the Cetacea

are absolutely isolated, and little satisfactory reason has ever been given for deriving them from any one of the existing divisions of the class more than from any other. The question has indeed often been mooted whether they have been derived from land mammals at all, or whether they may not be the survivors of a primitive aquatic form which was the ancestor not only of the whales, but of all the other members of the class. The materials for—I will not say solving—but for throwing some light upon this problem, must be sought for in two regions—in the structure of the existing members of the order, and in its past history, as revealed by the discovery of fossil remains. In the present state of science it is chiefly on the former that we have to rely.

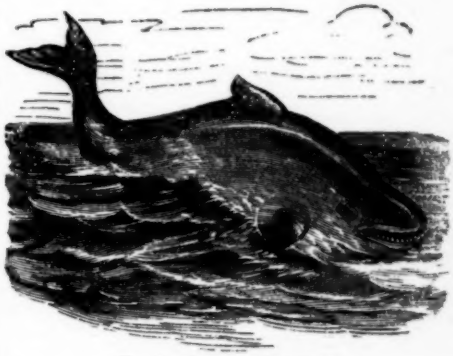

Fig. 2.—Common Porpoise.

One of the most obvious external characteristics by which the mammalia are distinguished from other classes of vertebrates is the more or less complete clothing of the surface by hair. The Cetacea alone appear to be exceptions to this generalization. Their smooth, glistening exterior is, in the greater number of species, at all events in adult life, absolutely bare, though the want of a hairy covering is compensated for functionally by peculiar modifications of the structure of the skin itself, the epidermis being greatly thickened, and a remarkable layer of dense fat closely incorporated with the tissue of the derm or true skin ; modifications admirably adapted for retaining the warmth of the body, without any roughness of surface which might occasion friction and so interfere with perfect facility of gliding through the water. Close examination, however, shows that the mammalian character of hairiness is not entirely wanting in the Cetacea, although it is reduced to a most rudimentary and apparently functionless condition.

In the organs of the senses the Cetacea exhibit some remarkable adaptive modifications of structures essentially formed on the mammalian type, and not on that characteristic of the truly aquatic vertebrates, the fishes.

The modifications of the organs of sight do not so much affect the eyeball as the accessory apparatus. To an animal whose surface is always bathed with fluid, the complex arrangement which mammals generally possess for keeping the surface of the transparent cornea moist and protected, the movable lids, the nictitating membrane, the lachrymal gland, and the arrangements for collecting and removing the superfluous tears when they have served their function can not be

needed, and hence we find these parts in a most rudimentary condition or altogether absent. In the same way the organ of hearing in its essential structure is entirely mammalian, having not only the sacculi and semicircular canals common to all but the lowest vertebrates, but the cochlea, and tympanic cavity with its ossicles and membrane, all, however, buried deep in the solid substance of the head; while the parts specially belonging to terrestrial mammals, those which collect the vibrations of the sound traveling through air, the pinna and the tube which conveys it to the sentient structures within, are entirely or practically wanting. Of the pinna or external ear there is no trace.

The organ of smell, when it exists, offers still more remarkable evidence of the origin of the Cetacea. In fishes this organ is specially adapted for the perception of odorous substances permeating the water; the terminations of the olfactory nerves are spread over a cavity near the front part of the nose, to which the fluid in which the animals swim has free access although it is quite unconnected with the respiratory passages. Mammals, on the other hand, smell substances with which the atmosphere they breathe is impregnated; their olfactory nerve is distributed over the more or less complex foldings of the lining of a cavity placed in the head, in immediate relation to the passages through which air is continually driven to and fro on its way to the lungs in respiration, and therefore in a most favorable position for receiving impressions from substances floating in that air. The whalebone whales have an organ of smell exactly on the mammalian type, but in a rudimentary condition. In the more completely modified Odontocetes the olfactory apparatus, as well as that part of the brain specially related to the function of smell, is entirely wanting, but in both groups there is not the slightest trace of the specially aquatic olfactory organ of fishes. Its complete absence and the vestiges of the aërial organ of land mammals found in the Mystacocetes are the clearest possible indications of the origin of the Cetaceæ from air-breathing and air-smelling terrestrial mammalia. With their adaptation to an aquatic mode of existence, organs fitted only for smelling in air became useless, and so have dwindled or completely disappeared. Time and circumstances have not permitted the acquisition of anything analogous to the special aquatic smelling apparatus of fishes, the result being that whales are practically deprived of whatever advantage this sense may be to other animals.

All the Cetacea present some traces of teeth, which in structure and mode of development resemble those of mammals, and not those of the lower vertebrated classes, but they are always found in a more or less imperfect state.

The meaning and utility of some of the strange modifications in the dentition of whales it is impossible, in the imperfect state of our knowledge of the habits of the Cetacea, to explain, but the fact that in almost every case a more full number of rudimentary teeth is pres-

ent in early stages of existence, which either disappear, or remain as concealed and functionless organs, points to the present condition in the aberrant and specialized forms as being one derived from the more generalized type, in which the teeth were numerous and equal.

FIG. 3.—TOOTHED WHALE, OR SPERMACETI WHALE.

The Mystacocetes, or whalebone whales, are distinguished by entire absence of teeth, at all events after birth. But it is a remarkable fact, first demonstrated by Geoffroy Saint-Hilaire, and since amply confirmed by Cuvier, Eschricht, Julin, and others, that in the fetal state they have numerous minute calcified teeth lying in the dental groove of both upper and lower jaws. These attain their fullest development about the middle of fetal life, after which period they are absorbed, no trace of them remaining at the time of birth. Their structure and mode of development have been shown to be exactly those characteristic of ordinary mammalian teeth. It is not until after the disappearance of these teeth that the baleen, or whalebone, makes its appearance. This remarkable structure, though only a modification of a part existing in all mammals, is, in its specially developed condition as baleen, peculiar to one group of whales.

Baleen consists of a series of flattened, horny plates, several hundred in number, on each side of the palate, separated by a bare interval along the middle line. They are placed transversely to the long axis of the palate, with very short spaces between them. Each plate or blade is somewhat triangular in form, with the base attached to the palate, and the apex hanging downward. The outer edge of the blade is hard and smooth, but the inner edge and apex fray out into long,

bristly fibers, so that the roof of the whale's mouth looks as if covered with hair, as described by Aristotle. The blades are longer near the middle of the series, and gradually diminish near the front and back of the mouth. The horny plates grow from a dense, fibrous, and highly vascular matrix, which covers the palatal surface of the maxillæ, and which sends out lamellar processes, one of which penetrates the base of each blade. Moreover, the free edge of these processes is covered with very long, vascular, thread-like papillæ, one of which forms the central axis of each of the hair-like epidermic fibers of which the blade is mainly composed. The blades are supported and bound together, for a certain distance from their base, by a mass of less hardened epithelium, secreted by the surface of the palatal membrane or matrix of the whalebone in the intervals of the lamellar processes. This is the "intermediate substance" of Hunter, the "gum" of the whalers.

The function of the whalebone is to strain the water from the small marine mollusks, crustaceans, or fish upon which the whales subsist. In feeding they fill the immense mouth with water containing shoals of these small creatures, and then, on their closing the jaws and raising

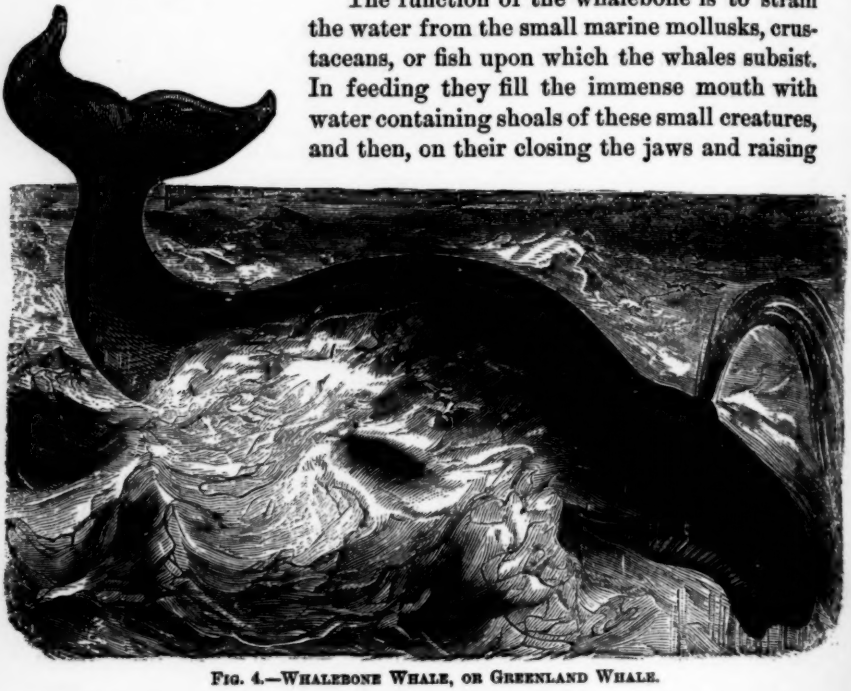

FIG. 4.—WHALEBONE WHALE, OR GREENLAND WHALE.

the tongue, so as to diminish the cavity of the mouth, the water streams out through the narrow intervals between the hairy fringe of the whalebone blades, and escapes through the lips, leaving the living prey to be swallowed. Almost all the other structures to which I am specially directing your attention are in a more or less rudimentary state in the Cetacea; the baleen, on the other hand, is an example of an exactly contrary condition, but an equally instructive one, as illustrating the mode in which Nature works in producing the infinite variety we

see in animal structures. Although appearing at first sight an entirely distinct and special formation, it evidently consists of nothing more than the highly modified papillæ of the lining membrane of the mouth, with an excessive and cornified epithelial development.

The bony palate of all mammals is covered with a closely-adhering layer of fibro-vascular tissue, the surface of which is protected by a coating of non-vascular epithelium, the former exactly corresponding to the derm or true skin, and the latter to the epiderm of the external surface of the body. Sometimes this membrane is perfectly smooth, but it is more often raised into ridges, which run in a direction transverse to the axis of the head, and are curved with the concavity backward; the ridges, moreover, do not extend across the middle line, being interrupted by a median depression or *raphé*. Indications of these ridges are clearly seen in the human palate, but they attain their greatest development in the Ungulata.

Though the early stages by which whalebone has been modified from more simple palate structures are lost to our sight, the conditions in which it now exists in different species of whales show very marked varieties of progress, from a simple, comparatively rudimental and imperfect condition, to what is perhaps the most wonderful example of mechanical adaptation to purpose known in any organic structure.

In the rorquals or fin-whales (genus *Balænoptera*), found in almost all seas, the largest blades in an animal of seventy feet in length do not exceed two feet in length, including their hairy terminations; they are in most species of a pale horn color, and their structure is coarse and inelastic, separating into thick, stiff fibers, so that they are of no value for the ordinary purposes to which whalebone is applied in the arts. These animals feed on fish of considerable size, from herrings up to cod, and for foraging among shoals of these creatures the construction of their mouth and the structure of their baleen are evidently sufficient. This is the type of the earliest known extinct forms of whales, and it has continued to exist, with several slight modifications, to this day, because it has fulfilled one purpose in the economy of Nature. Other purposes for which it was not sufficient have been supplied by gradual changes taking place, some of the stages of which are seen in the intermediate conditions still exhibited in the Megaptera and the Atlantic and southern right whales.

In the Greenland right whale of the circumpolar seas, the Bowhead of the American whalers (*Balæna mysticetus*), all the peculiarities which distinguish the head and mouth of the whales from other mammals have attained their greatest development. The head is of enormous size, exceeding one third of the whole length of the creature. The cavity of the mouth is actually larger than that of the body, thorax, and abdomen together. The upper jaw is very narrow, but greatly arched from before backward, to increase the height of the cavity and allow for the great length of the baleen; the enormous rami

of the mandibles are widely separated posteriorly, and have a still further outward sweep before they meet at the symphysis in front, giving the floor of the mouth the shape of an immense spoon. The baleen-blades attain the number of three hundred and fifty or more on each side, and those in the middle of the series have a length of ten or even twelve feet. They are black in color, fine and highly elastic in texture, and fray out at the inner edge and ends into long, delicate, soft, almost silky, but very tough hairs.

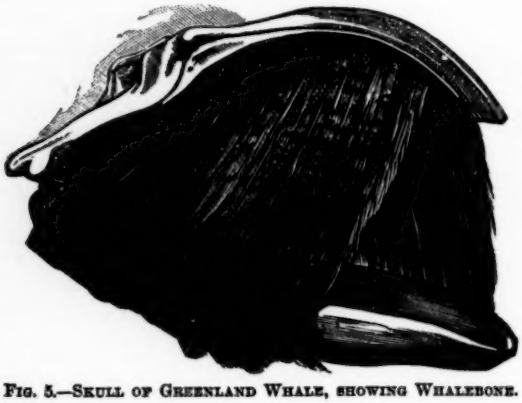

FIG. 5.—SKULL OF GREENLAND WHALE, SHOWING WHALEBONE.

How these immensely long blades, depending vertically from the palate, were packed into a mouth the height of which was scarcely more than half their length, was a mystery not solved until a few years ago. Captain David Gray, of Peterhead, at my request, first gave us a clear idea of the arrangement of the baleen in the Greenland whale, and showed that the purpose of its wonderful elasticity was not primarily at least the benefit of the corset and umbrella makers, but that it was essential for the correct performance of its functions. It may here be mentioned that the modification of the mouth-structure of the right whale is entirely in relation to its food. It is by this apparatus that it is enabled to avail itself of the minute but highly nutritious crustaceans and pteropods which swarm in immense shoals in the seas it frequents. The large mouth enables it to take in at one time a sufficient quantity of water filled with these small organisms, and the length and delicate structure of the baleen make it an efficient strainer or hair sieve by which the water can be drained off. If the baleen were, as in the rorquals, short and rigid, and only of the length of the aperture between the upper and lower jaws when the mouth was shut, when the jaws were separated a space would be left beneath it through which the water and the minute particles of food would escape together. But, instead of this, the long, slender, brush-like ends of the whalebone-blades, when the mouth is closed, fold back, the front ones passing below the hinder ones in a channel lying between the

tongue and the bone of the lower jaw. When the mouth is opened their elasticity causes them to straighten out like a bow that is unbent, so that, at whatever distance the jaws are separated, the strainer remains in perfect action, filling the whole of the interval. The mechanical perfection of the arrangement is completed by the great development of the lower lip, which rises stiffly above the jawbone, and prevents the long, slender, flexible ends of the baleen being carried outward by the rush of water from the mouth.

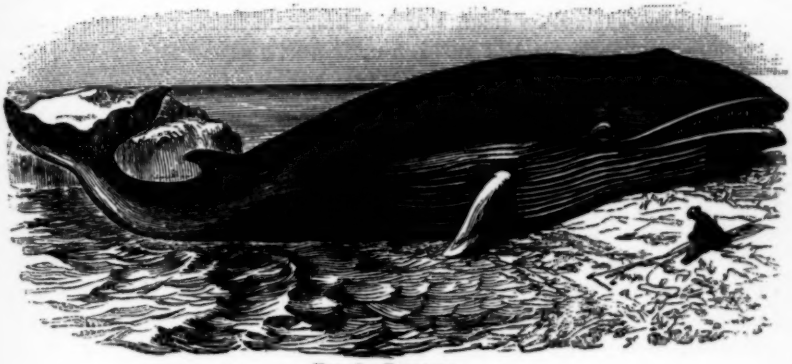

FIG. 6.—RORQUAL.

Few points of the structure of whales offer so great a departure from the ordinary mammalian type as the limbs. The fore-limbs are reduced to the condition of simple paddles or oars, variously shaped, but always flattened and more or less oval in outline. They are freely movable at the shoulder-joint, where the humerus or upper-arm bone articulates with the shoulder-blade in the usual manner, but beyond this point, except a slight flexibility and elasticity, there is no motion between the different segments. The bones are all there, corresponding in number and general relations with those of the human or any other mammalian arm, but they are flattened out, and their contiguous ends, instead of presenting hinge-like joints, come in contact by flat surfaces, united together by strong ligamentous bands, and all wrapped up in an undivided covering of skin, which allows externally of no sign of the separate and many-jointed fingers seen in the skeleton.

The changes that have taken place in the hind-limbs are even more remarkable. In all known Cetacea (unless *Platanista* be really an exception) a pair of slender bones are found suspended a short distance below the vertebral column, but not attached to it, about the part where the body and the tail join. In museum skeletons these bones are often not seen, as, unless special care has been taken in the preparation, they are apt to get lost. They are, however, of much importance and interest, as their relations to surrounding parts show that they are the rudimentary representatives of the pelvic or hip bones, which in other mammals play such an important part in con-

necting the hind-limbs with the rest of the skeleton. The pelvic arch is thus almost universally present, but of the limb proper there is, as far as is yet known, not a vestige in any of the large group of toothed whales, not even in the great Cachalot or sperm whale, although it should be mentioned that it has never been looked for in that animal with any sort of care. With regard to the whalebone whales, at least to some of the species, the case is different. In these animals there are found, attached to the outer and lower side of the pelvic bone, other elements, bony or only cartilaginous as the case may be, clearly representing rudiments of the first and in some cases the second segment of the limb, the thigh or femur, and the leg or tibia.

We have here a case in which it is not difficult to answer the question before alluded to, often asked with regard to rudimentary parts: Are they disappearing, or are they incipient organs? We can have no hesitation in saying that they are the former. All we know of the origin of limbs shows that they commence as outgrowths upon the surface of the body, and that the first-formed portions are the most distal segments. The limb, as proved by its permanent state in the lowest vertebrates, and by its embryological condition in higher forms, is at first a mere projection or outward fold of the skin, which, in the course of development, as it becomes of use in moving or supporting the animal, acquires the internal framework which strengthens it and perfects its functions. It would be impossible, on any theory of causation yet known, to conceive of a limb gradually developed from within outward. On the other hand, its disappearance would naturally take place in the opposite direction.

We turn next to what the researches of paleontology teach of the past history of the order. Unfortunately, this does not at present amount to very much. We know nothing of their condition, if they existed, in the Mesozoic age. Even in the cretaceous seas not a fragment of any whale or whale-like animal has been found. The earliest Cetaceans, of whose organization we have any good evidence, are the Zeuglodons of the Eocene formations of North America. These were creatures whose structure, as far as we know it, was intermediate between that of the existing sub-orders of whales. In fact, *Zeuglodon* is precisely what we might have expected *a priori* an ancestral form of whales to have been. From the middle Miocene period fossil Cetacea are abundant, and distinctly divided into the two groups now existing. The Mystacocetes, or whalebone whales, of the Miocene seas, were, as far as we know now, only *Balænopteræ*, some of which were more generalized than any now existing. In the shape of the mandible also, Van Beneden discerns some approximation to the Odontocetes. Right whales (*Balæna*) have not been found earlier than the Pliocene period, and it is interesting to note that, instead of the individuals diminishing in bulk as we approach the times we live in, as with many other groups of animals, the contrary has been the case, no known extinct species

of whales equaling in size those that are now to be met with in the ocean. The size of whales, as of all other things whose most striking attribute is magnitude, has been greatly exaggerated; but, when reduced to the limits of sober fact, the Greenland right whale of fifty feet long, the sperm whale of sixty, and the great northern rorqual (*Balænoptera Sibbaldii*) of eighty, exceed all other organic structures known, past or present. Instead of living in an age of degeneracy of physical growth, we are in an age of giants, but it may be at the end of that age. For countless ages impulses from within and the forces of circumstances from without have been gradually shaping the whales into their present wonderful form and gigantic size, but the very perfection of their structure and their magnitude combined, the rich supply of oil protecting their internal parts from cold, the beautiful apparatus of whalebone by which their nutrition is provided for, have been fatal gifts, which, under the sudden revolution produced on the surface of the globe by the development of the wants and arts of civilized man, can not but lead in a few years to their extinction.

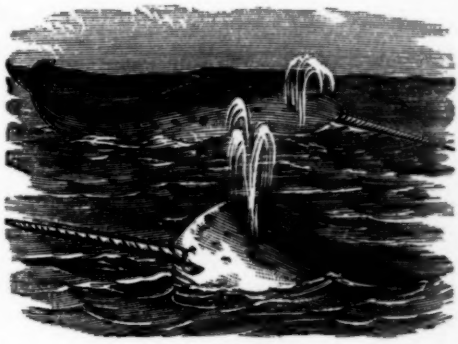

FIG. 7.—NARWHAL.

Let us return to the question with which we started, "What was the probable origin of whales?" The evidence is absolutely conclusive that they were not originally aquatic in habit, but are derived from terrestrial mammals of fairly high organization, belonging to the placental division of the class—animals in which a hairy covering was developed, and with sense-organs, especially that of smell, adapted for living on land; animals, moreover, with four completely developed pairs of limbs on the type of the higher vertebrata, and not of that of fishes.

One of the methods by which a land mammal may have been changed into an aquatic one is clearly shown in the stages which still survive among the carnivora. The seals are obviously modifications of the land carnivora, the Otaria, or sea-lions and sea-bears, being curiously intermediate. Many naturalists have been tempted to think that the whales represent a still further stage of the same kind of modification. But there is to my mind a fatal objection to this view. The seal, of course, has much in common with the whale, inasmuch as it is a mammal adapted for an aquatic life, but it has been converted to its general fish-like form by the peculiar development of its hind-limbs into instruments of propulsion through the water; for, though

the thighs and legs are small, the feet are large and are the special organs of locomotion in the water, the tail being quite rudimentary. In the whales the hind-limbs are aborted and the tail developed into a powerful swimming organ. Now, it is very difficult to suppose that, when the hind-limbs had once become so well adapted to a function so essential to the welfare of the animal as that of swimming, they could ever have become reduced and their action transferred to the tail. It is far more reasonable to suppose that whales were derived from animals with large tails, which were used in swimming, eventually with such effect that the hind-limbs became no longer necessary, and so gradually disappeared. The powerful tail, with lateral cutaneous flanges, of an American species of otter (*Pteronura sandbachii*), or the still more familiar tail of the beaver, may give some idea of this member in the primitive *Cetacea*.

As pointed out long ago by Hunter, there are numerous points in the structure of the visceral organs of the Cetacea far more resembling those of the Ungulata than the Carnivora. These are the complex stomach, simple liver, respiratory organs, and especially the reproductive organs and structures relating to the development of the young. I can not help thinking that some insight has been shown in the common names attached to one of the most familiar of Cetaceans by those whose opportunities of knowing its nature have been greatest—"sea-hog," "sea-pig," or "herring-hog," of our fishermen, *Meerschwein* of the Germans, corrupted into the French "marsouin," and also "porcpoisson," shortened into "porpoise." A difficulty that might be suggested in the derivation of the Cetacea from the Ungulata, arising from the latter being at the present day mainly vegetable-feeders, is not great, as the primitive ungulates were probably omnivorous, as their least modified descendants, the pigs, are still; and the aquatic branch might easily have gradually become more and more piscivorous, as we know, from the structure of their bones and teeth, the purely terrestrial members have become by degrees more exclusively graminivorous.

One other consideration may remove some of the difficulties that may arise in contemplating the transition of land mammals into whales. The Gangetic dolphin (*Platanista*) and the somewhat related *Inia* of South America, which retain several rather generalized mammalian characters, and are related to some of the earliest known European Miocene forms, are both to the present day exclusively fluviatile, being found in the rivers they inhabit almost up to their very sources, more than a thousand miles from the sea. May this not point to the fresh-water origin of the whole group, and thus account for their otherwise inexplicable absence from the Cretaceous seas?

THE FUEL OF THE FUTURE.

By GEORGE WARDMAN.

THE practical application of natural gas, as an article of fuel, to the purpose of manufacturing glass, iron, and steel, promises to work a revolution in the industrial interests of America—promises to work a revolution; for, notwithstanding the fact that, in many of the largest iron, steel, and glass factories in Pittsburg and its vicinity, natural gas has already been substituted for coal, the managers of some such works are shy of the new fuel, mainly for two reasons: 1. They doubt the continuity and regularity of its supply; 2. They do not deem the difference between the price of natural gas and coal sufficient, as yet, to justify the expenditure involved in the furnace changes necessary to the substitution of the one for the other. These two objections will doubtless disappear with additional experience in the production and regulation of the gas-supply, and with enlarged competition among the companies engaging in its transmission from the wells to the works. At present the use of natural gas as a substitute for coal in the manufacture of glass, iron, and steel, is in its infancy.

Natural gas is as ancient as the universe. It was known to man in prehistoric times, we must suppose, for the very earliest historical reference to the Magi of Asia records them as worshiping the eternal fires which then blazed, and still blaze, in fissures of the mountain-heights overlooking the Caspian Sea. Those records appertain to a period at least 600 years before the birth of Christ; but the Magi must have lived and worshiped long anterior to that time.

Zoroaster, reputed founder of the Parsee sect, is placed contemporary with the prophet Daniel, from 2500 to 600 B. C.; and, although Daniel has been doubted, and Zoroaster may never have seen the light, the fissures of the Caucasus have been flaming since the earliest authentic records.

Tho Parsees (Persians) did not originally worship fire. They believed in two great powers—the Spirit of Light, or Good, and the Spirit of Darkness, or Evil. Subsequent to Zoroaster, when the Persian Empire rose to its greatest power and importance, overspreading the west to the shores of the Caspian and beyond, the tribes of the Caucasus suffered political subjugation; but the creed of the Magi, founded upon the eternal flame-altars of the mountains, proved sufficiently vigorous to transform the Parseeism of the conquerors to the fire-worship of the conquered.

About the beginning of the seventh century of the Christian era, the Grecian Emperor Heraclius overturned the fire-altars of the Magi at Baku, the chief city on the Caspian, but the fire-worshipers were

not expelled from the Caucasus until the Mohammedans subjugated the Persian Empire, when they were driven into the Rangoon, on the Irrawaddy, in India, one of the most noted petroleum-producing districts of the world.

Petroleum and natural gas are so intimately related that one would hardly dare to say whether the gas proceeds from petroleum or the petroleum is deposited from the gas. It is, however, safe to assume that they are the products of one material, the lighter element separating from the heavier under certain degrees of temperature and pressure. Thus, petroleum may separate from the gas as asphaltum separates from petroleum. But some speculative minds consider natural gas to be a product of anthracite coal. The fact that the great supply-field of natural gas in Western Pennsylvania, New York, West Virginia, and Eastern Ohio, is a bituminous and not an anthracite region, does not, of itself, confute that theory; as the argument for it is, that the gas may be tapped at a remote distance from the source of supply, and, whereas anthracite is not a gas-coal, while bituminous is, we are told to suppose that the gas which once may have been a component part of the anthracite was long ago expelled by Nature, and has since been held in vast reservoirs with slight waste, awaiting the use of man. That is one theory; and upon that supposition it is suggested that anthracite may exist below the bituminous beds of the region lying between the Alleghany Mountains and the Great Lakes. Another theory is, that natural gas is a product of the sea-weed deposited in the Devonian stratum. But, leaving modern theories on the origin of natural gas and petroleum, we may suppose the natural gas-jets now burning in the fissures of the Caucasus to have started up in flames about the time when, according to the Old Testament, Noah descended from Mount Ararat, or very soon thereafter. In the language of modern science it would be safe to say that those flames sprang up when the Caucasus range was raised from beneath the surface of the universal sea. The believer in biblical chronology may say that those fires have been burning for four thousand years—the geologist may say for four millions.

We know that Alexander the Great penetrated to the Caspian; and in Plutarch we read: "Hence [Arbela] he marched through the province of Babylon [Media?], which immediately submitted to him, and in Ecbatana [?] was much surprised at the sight of the place where fire issues in a continuous stream, like a spring of water, out of a cleft in the earth, and the stream of naphtha, which not far from this spot flows out so abundantly as to form a large lake. This naphtha, in other respects resembling bitumen, is so subject to take fire that, before it touches the flame, it will kindle at the very light that surrounds it, and often inflame the intermediate air also. The barbarians, to show the power and nature of it, sprinkled the street that led to the king's lodgings with little drops of it, and, when it was

almost night, stood at the farther end with torches, which being applied to the moistened places, the first taking fire, instantly, as quick as a man could think of it, it caught from one end to another in such manner that the whole street was one continued flame. Among those who used to wait upon the king, and find occasion to amuse him, when he anointed and washed himself, there was one Athenophanus, an Athenian, who desired him to make an experiment of the naphtha upon Stephanus, who stood by in the bathing-place, a youth with a ridiculously ugly face, whose talent was singing well. 'For,' said he, 'if it take hold of him, and is not put out, it must undeniably be allowed to be of the most invincible strength.' The youth, as it happened, readily consented to undergo the trial, and, as soon as he was anointed and rubbed with it, his whole body broke out into such a flame, and was so seized by the fire, that Alexander was in the greatest perplexity and alarm for him, and not without reason; for nothing could have prevented his being consumed by it if, by good chance, there had not been people at hand with a great many vessels of water for the service of the bath, with all which they had much ado to extinguish the fire; and his body was so burned all over that he was not cured of it a good while after. And thus it is not without some plausibility that they endeavor to reconcile the fable to truth, who say this was the drug in the tragedies with which Medea anointed the crown and veils which she gave to Creon's daughter."

An interesting reference to the fire-worshipers of the Caucasus is contained in the "History of Zobeide," a tale of the wonderful Arabian Nights Entertainment. It runs thus:

"I bought a ship at Balsora, and freighted it; my sisters chose to go with me, and we set sail with a fair wind. Some weeks after we cast anchor in a harbor which presented itself, with intent to water the ship. As I was tired with having been so long on board, I landed with the first boat, and walked up into the country. I soon came in sight of a great town. When I arrived there I was much surprised to see vast numbers of people in different postures, but all immovable. The merchants were in their shops, the soldiery on guard; every one seemed engaged in his proper avocation, yet all were become as stone. . . . I heard the voice of a man reading Al Koran. . . . Being curious to know why he was the only living creature in the town, . . . he proceeded to tell me that the city was the metropolis of a kingdom now governed by his father; that the former king and all his subjects were Magi, worshipers of fire and of Nardoun, the ancient king of the giants who rebelled against God. 'Though I was born,' continued he, 'of idolatrous parents, it was my good fortune to have a woman governess who was a strict observer of the Mohammedan religion. She taught me Arabic from Al Koran; by her I was instructed in the true religion, which I would never afterward renounce. About three years ago a thundering voice was heard distinctly throughout the city, say-

ing, "Inhabitants, abandon the worship of Nardoun and of fire, and worship the only true God, who showeth mercy!" This voice was heard three years successively, but no one regarded it. At the end of the last year all the inhabitants were in an instant turned to stone. I alone was preserved.'"

In the foregoing tale we doubtless have reference to the destruction of Baku, on the Caspian (though to sail from Balsora to Baku is impossible), and the driving away into India, by the Arabs under Caliph Omar, of all who refused to renounce fire-worship and adopt the creed of the Koran. The turning of the refractory inhabitants into stone is probably the Arabian story-teller's figurative manner of referring to the finding of dead bodies in a mummified condition.

It is known that the Egyptians made use of bitumen, in some form, in the preservation of their dead, a fact with which the Arabians were familiar. As the Magi held the four elements of earth, air, fire, and water to be sacred, they feared to either bury, burn, sink, or expose to air the corrupting bodies of their deceased. Therefore, it was their practice to envelop the corpse in a coating of wax or bitumen, so as to hermetically seal it from immediate contact with either of the four sacred elements. Hence the idea of all the bodies of the Magi left at Baku being turned to stone, while only the true believer in Mohammed remained in the flesh.

Marco Polo, the famous traveler of the thirteenth century, makes reference to the burning jets of the Caucasus, and those fires are known to the Russians as continuing in existence since the army of Peter the Great wrested the regions about the Caspian from the modern Persians. The record of those flaming jets of natural gas is thus brought down in an unbroken chain of evidence from remote antiquity to the present day, and they are still burning.

Numerous Greek and Latin writers testify to the known existence of petroleum about the shores of the Mediterranean two thousand years ago. More modern citations may, however, be read with equal interest. In the "Journal of Sir Philip Skippon's Travels in France," in 1663, we find the following curious entries:

"We stayed in Grenoble till August 1st, and one day rode out, and, after twice fording the river Drac (which makes a great wash) at a league's distance, went over to Pont de Clef, a large arch across that river, where we paid one sol a man; a league further we passed through a large village called Vif, and about a league thence by S. Bathomew, another village, and Chasteau Bernard, where we saw a flame breaking out of the side of a bank, which is vulgarly called *La Fountaine qui Brule;* it is by a small rivulet, and sometimes breaks out in other places; just before our coming some other strangers had fried eggs here. The soil hereabouts is full of a black stone, like our coal, which, perhaps, is the continual fuel of the fire. . . . Near Peroul, about a league from Montpelier, we saw a boiling fountain (as they

call it), that is, the water did heave up and bubble as if it boiled. This phenomenon in the water was caused by a vapor ascending out of the earth through the water, as was manifest, for if that one did but dig anywhere near the place, and pour water upon the place new digged, one should observe in it the like bubbling, the vapor arising not only in that place where the fountain was, but all thereabout; the like vapor ascending out of the earth and causing such ebullition in water it passes through hath been observed in Mr. Hawkley's ground, about a mile from the town of Wigan, in Lancashire, which vapor, by the application of a lighted candle, paper, or the like, catches fire and flames vigorously. Whether or not this vapor at Peroul would in like manner catch fire and burn I cannot say, it coming not in our minds to make the experiment. . . . At Gabian, about a day's journey from Montpelier, in the way to Beziers, is a fountain of petroleum. It burns like oil, is of a pungent scent, and a blackish color. It distills out of several places of the rock all the year long, but most in the summer time. They gather it up with ladles and put it in a barrel set on end, which hath a spiggot just at the bottom. When they have put in a good quantity they open the spiggot to let out the water, and when the oil begins to come presently stop it. They pay for the farm of this fountain about fifty crowns per annum. We were told by one Monsieur Beaushoste, a chymist in Montpelier, that petroleum was the very same with oil of jet, and not to be distinguished from it by color, taste, smell, consistency, virtues, or any other accident, as he had by experience found upon the coast of the Mediterranean Sea, in several places, as at Berre, near Martague, in Provence; at Messina, in Sicily, etc."

In Harris's "Voyages," published in 1764, an article on the empire of Persia thus refers to petroleum:

"In several parts of Persia we meet with naphtha, both white and black; it is used in painting and varnish, and sometimes in physic, and there is an oil extracted from it which is applied to several uses, The most famous springs of naphtha are in the neighborhood of Baku. which furnish vast quantities, and there are also upwards of thirty springs about Shamasky, both in the province of Schirwan. The Persians use it as oil for their lamps and in making fireworks, of which they are extremely fond, and in which they are great proficients."

Petroleum has long been known to exist also in the northern part of Italy, the cities of Parma and Genoa having been for many years lighted with it.

In the province of Szechuen, China, natural gas is obtained from beds of rock-salt at a depth of fifteen to sixteen hundred feet. Being brought to the surface, it is conveyed in bamboo tubes and used for lighting as well as for evaporating water in the manufacture of salt. It is asserted that the Chinese used this natural gas for illuminating purposes long before gas-lighting was known to the Europeans. Re-

membering the unprogressive character of Chinese arts and industries, there is ground for the belief that they may have been using this natural gas as an illuminant these hundreds of years.

In the United States the existence of petroleum was known to the Pilgrim Fathers, who doubtless obtained their first information of it from the Indians, for whom, in New York and Western Pennsylvania, it was called Seneka-oil. It was otherwise known as "British" oil and oil of naphtha, and was considered "a sovereign remedy for an inward bruise."

The record of natural gas in this country is not so complete as that of petroleum, but we learn that an important gas-spring was known in West Bloomfield, N. Y., seventy years ago. In 1864 a well was sunk to a depth of three hundred feet upon that vein, from which a sufficient supply of gas was obtained to illuminate and heat the city of Rochester (twenty-five miles distant) it was supposed. But the pipes which were laid for that purpose, being of wood, were unfitted to withstand the pressure, in consequence of which the scheme was abandoned; but gas from that well is now in use as an illuminant and as fuel both in the town of West Bloomfield and at Honeoye Falls. The village of Fredonia, N. Y., has been using natural gas in lighting the streets for thirty years or thereabout. On Big Sewickley Creek, in Westmoreland County, Pa., natural gas was used for evaporating water in the manufacture of salt thirty years ago, and gas is still issuing at the same place. Natural gas has been in use in several localities in Eastern Ohio for twenty-five years, and the wells are flowing as vigorously as when first known. It has also been in use in West Virginia for a quarter of a century, as well as in the petroleum region of Western Pennsylvania, where it has long been utilized in generating steam for drilling oil-wells.

In 1826 the "American Journal of Science" contained a letter from Dr. S. P. Hildreth, who, in writing of the products of the Muskingum (Ohio) Valley, said: "They have sunk two wells, which are now more than four hundred feet in depth; one of them affords a very strong and pure salt-water, but not in great quantity; the other discharges such vast quantities of petroleum, or, as it is vulgarly called, 'Seneka-oil,' and besides is so subject to such tremendous explosions of gas, as to force out all the water and afford nothing but gas for several days, that they make little or no salt."

The value of the foregoing references is to be found in the testimony they offer as to the duration of the supply of natural gas. Whether we look to the eternal flaming fissures of the Caucasus, or to New York, Pennsylvania, and Ohio, there is much to encourage the belief that the flow of natural gas may be, like the production of petroleum, increased rather than diminished by the draughts made upon it. Petroleum, instead of diminishing in quantity by the millions of barrels drawn from Western Pennsylvania in the last quarter

of a century, seems to increase, greater wells being known in 1884 than in any previous year, and prices having fallen from two dollars per bottle for "Seneka-oil" to sixty cents per barrel for the same article under the name of crude petroleum. Hence we may assume that, as new pipe-lines are laid, the supply of natural gas available for use in the great manufacturing district of Pittsburg and vicinity will be increased, and the price of this fuel diminished in a corresponding ratio.

Natural gas is now supplied in Pittsburg at a small discount on the actual cost of coal used last year in the large manufacturing establishments, an additional saving being made in dispensing with firemen and avoidance of hauling ashes from the boiler-room. It is supplied, for domestic purposes, at twenty cents per one thousand cubic feet, which is not cheaper than coal in Pittsburg, but it is a thousand per cent cleaner; and in that respect it promises to prove a great blessing, not only to those who can afford to use it, but to the community at large, in the hope held out that the smoke and soot nuisance may be abated in part, if not wholly subdued, and that gleams of sunshine there may become less phenomenal in the future than they are at the present time. Twenty cents per thousand feet is too high a price to bring gas into general use for domestic purposes in a city where coal is cheap. Ten cents would be too much, and no doubt five cents per thousand would pay a profit. The fact is, the dealers in natural gas appear to be somewhat doubtful of the continuity of supply, and anxious to get back the cost of wells and pipes in one year, which, if successful, would be an enormous return on the investment.

There are objections to the use of natural gas by mill-operators—that it costs too much, and that the continuity of the supply is uncertain; by heads of families, that it is odorless, and, in case of leakage from the pipes, may fill a room and be ready to explode without giv ing the fragrant warning offered by common gas. Both of these objections will probably disappear under the experience that time must furnish. More wells and tributary lines will lessen the cost and tend to regulate the pressure for manufacturers. Cut-offs and escape-pipes outside of the house will reduce the risk of explosions within. The danger in the house may also be lessened by providing healthful ventilation in all apartments wherein gas shall be consumed.

This subject of the ventilation of rooms in which common gas is ordinarily used is beginning to attract attention. It is stated, upon scientific authority, that a jet of common gas, equivalent to twelve sperm-candles, consumes 5·45 cubic feet of oxygen per hour, producing 3·21 feet of carbonic-acid gas, vitiating, according to Dr. Tidy's "Handbook of Chemistry," 348·25 cubic feet of air. In every five cubic feet of pure air in a room there is one cubic foot of oxygen and four of nitrogen. Without oxygen human life, as well as light, would become extinct. It is asserted that one common gas-jet consumes as much oxygen as five persons.

Carbonic-acid gas is the element which, in deep mines and vaults, causes almost instant insensibility and suffocation to persons subjected to its influences, and instantly extinguishes the flame of any light lowered into it. The normal quantity of this gas contained in the air we breathe is ·04; one per cent of it causes distress in breathing; two per cent is dangerous; four per cent extinguishes life, and four per cent of it is contained in air expelled from the lungs. According to Dr. Tidy's table, each ordinary jet of common gas contributes to the air of a room sixteen by ten feet on the sides and nine feet high, containing 1,440 cubic feet of air, twenty-two per cent of carbonic-acid gas, which, continued for twenty hours without ventilation, would reach the fatal four per cent.

Professor Huxley gives, as a result of chemical analyses, the following table of ratio of carbonic-acid gas in the atmosphere at the points named:

On the Thames, at London	·0343
In the streets of London	·0380
Top of Ben Nevis	·0327
Dress circle of Haymarket Theatre (11.30 P. M.)	·0757
Chancery Court (seven feet from the ground)	·1930
From working mines (average of 339 samples)	·7852
Largest amount in a Cornish mine	2·0500

In addition to the consumption of oxygen and production of carbonic acid by the use of common gas, the gas itself, owing to defectiveness of the burner, is projected into the air. Now, considering the deleterious nature of all illuminating gases, the reasons for perfect ventilation of rooms in which natural gas is used for heating and culinary purposes are self-evident, not alone as a protection against explosions, but for the health of the occupants of the house, remembering that a larger supply of oxygen is said to be necessary for the perfect combustion of natural than of common gas.

Carbonic oxide, formed by the consumption of carbon, with an insufficient supply of air, is the fatal poison of the charcoal-furnace, not infrequently resorted to, in close rooms, as a means of suicide. The less sufficient the air toward perfect combustion, the smaller the quantity of carbonic acid and the greater the amount of carbonic oxide. That is to say, at the time of ignition the chief product of combustion is carbonic oxide, and, unless sufficient air be added to convert the oxide to carbonic acid, a decidedly dangerous product is given off into the room. Yet, by means of a flue to carry off the poisonous gases from burning jets, the combustion of gas, creating a current, is made an aid to ventilation. Unfortunately, this important fact, if commonly known, is not much heeded by heads of families or builders of houses. But in any large community where gas comes into general use as an article of fuel, this fact will gradually become recognized and respected.

The property of indicating the presence of very minute quantities of gas in a room is claimed for an instrument recently described by C. von Jahn, in the "Revue Industrielle." This is a porous cup, inverted and closed by a perforated rubber stopper. Through the perforation in the stopper the interior of the cup is connected with a pressure-gauge containing colored water. It is claimed that the diffusion of gas through the earthenware raises the level of the water in the gauge so delicately that the presence of one half of one per cent of gas may be detected by it. Other instruments of a slightly different character are credited by their inventors with most sensitive power of indicating gas-leakages, but their practical efficiency remains to be demonstrated. An automatic cut-off for use outside of houses in which natural gas is consumed has been invented, but this writer knows nothing of either its mode of action or its effectiveness.

The great economic question, however, connected with the use of natural gas is, How will it affect the industrial interests of the country? There are grounds for the belief that a sufficient supply of natural gas may be found in the vicinity of Pittsburg to reduce the cost of fuel to such a degree as to make competition in the manufacture of iron, steel, and glass, in any part of the country where coal must be used, out of the question. Such a condition of affairs would probably result in driving the great manufacturing concerns of the country into the region where natural gas is to be obtained. That may be anywhere from the western slope of the Alleghanies to Lake Erie or to Lake Michigan. And, if the cost of producing iron, steel, and glass can be so cheapened by the new fuel, the tariff question may undergo some important modification in politics. For, if the reduction in the cost of fuel should ever become an offset to the lower rate of wages in Europe, the manufacturers of Pennsylvania, who have long been the chief support of the protective policy of the country, may lose their present interest in that question, and leave the tariff to shift for itself elsewhere. It should be remembered that natural gas is not, as yet, much cheaper than coal in Pittsburg. But it may safely be assumed that it will cheapen, as petroleum has done, by a development of the territory in which it is known to exist in enormous quantities. It is quite possible that, instead of buying gas, many factories will bore for it with success, or remove convenient to its natural sources, so that a gas-well may ultimately become an essential part of the "plant" of a mill or factory. Even now coal can not compete with gas in the manufacture of window-glass, for, the gas being free from sulphur and other impurities contained in coal, produces a superior quality of glass; so that in this branch of industry the question of superiority seems already settled.

Having said thus much of an industry now in its infancy but promising great growth, I submit tables of analyses of common and of the natural or marsh gas, the latter from a paper recently prepared by a

TABLE OF ANALYSIS OF NATURAL GAS—FROM VARIOUS SOURCES.

CONSTITUENTS.	1. Petrolia, Canada.	2. West Bloomfield, N. Y.	3. Olean, N. Y.	4. Fredonia, N. Y.	5. Pioneer Run, Venango Co., Pa.	6. Burns's Well, near St. Joe., Butler Co., Pa.	7. Harvey Well, Butler Co., Pa.	8. Cherry Tree, Indiana Co., Pa.	9. Leechburg, Pa.	10. Creighton, Pa.	11. Penn Fuel Co.'s Well, Murraysville, Pa.	12. Fuel Gas Co.'s Well, Murraysville.	13. Foger's Gulch, Wirt Co., W. Va.	14. Gas from Marsh Ground.	15. Baku, on the Caspian Sea.	16. Gas occluded in Wigan cannel-coal.	17. Blower in coal-mine, South Wales.
Hydrogen	Chiefly marsh-gas, with ethane and some carbonic acid.	....	....	A mixture of marsh-gas, ethane, and butane.	Chiefly propane, with small quantities of carbonic acid and nitrogen.	6·10	13·50	22·50	4 79	....	Marsh-gas, with a little carbonic acid.	19·56	Chiefly marsh-gas, with small quantities of nitrogen and 15·86 per cent carbonic acid.	....	0·98	....	....
Marsh-gas		82·41	96·50			75·44	80·11	60·27	89·65	96·34		78·24		47·37	93·09	80·69	95·42
Ethane		....	....			18·12	5·72	6·80	4·39	....		....		....	....	4·75	....
Propane		...	....			trace.	....	....	trace.	....		....		....	....	....	....
Carbonic acid		10·11	....			0·34	0·66	2·28	0·35	3·64		....		3·10	2·18	6·44	0·60
Carbonic oxide		....	0·50			trace.	trace.	trace.	0 26	Trace of heavy hydrocarbons.		....		....	....	....	....
Nitrogen		4·31	....			....	....	7·32	....			....		49·39	0·49	8·12	3·98
Oxygen		0·23	2·00			....	....	0·83	....			2·20		0·17	....	....	....
"Illuminating hydrocarbons."		2·94	1·00			....	....	....	0·56			....		....	3·26	....	....
		100·00	100·00			100.00	99·99	100·00	100·00			100·00		100·03	100·00	100·00	100·00
Specific gravity		0·693	0·692			0·6148	0·5119		0·5580	0·5923	0·56						

1. Fouqué, "Comptes Rendus," lxvii, p. 1045.
2. H. Wurtz, "Am. Jour. Arts and Sci." (2), xlix, p. 336.
3. Robert Young.
4. Fouqué, "Comptes Rendus," lxvii, p. 1045.
5. Fouqué, "Comptes Rendus," lxvii, p. 1045.
6. S. P. Sadtler, "Report L, 2d Geol. Sur. Pa.," p. 153.
7. S. P. Sadtler, "Report L, 3d Geol. Sur., Pa.," p. 152.
8. S. P. Sadtler, "Report L, 3d Geol. Sur., Pa.," p. 153.
9. S. P. Sadtler, "Report L, 3d Geol. Sur., Pa.," p. 153.
10. F. C. Phillips.
11. Robert Young.
12. Rogers.
13. Fouqué, "Comptes Rendus," lxvii, p. 1045.
14. Bischof's "Chemical Geology," I, p. 730.
15. Bischof's "Chemical Geology," I, p. 730.
16. J. W. Thomas, London, "Chemical Society's Journal," 1876, p. 793.
17. Same, 1875, p. 793.

Petroleum is composed of about 85 per cent of carbon and 15 per cent of nitrogen.

committee of the Engineers' Society of Western Pennsylvania, and for the use of which I am indebted to that association:

COMMON GAS.	
Hydrogen	46·0
Light carbureted hydrogen (marsh-gas)	39·5
Condensible hydrocarbon	3·8
Carbonic oxide	7·5
" acid	0·6
Aqueous vapor	2·0
Oxygen	0·1
Nitrogen	0·5
	100·00

Natural gas is now conveyed to Pittsburg through four lines of 5⅝-inch pipe, and one line of eight-inch pipe. A line of ten-inch pipe is also being laid. The pressure of the gas at the wells is from 150 to 230 pounds to the square inch. As the wells are on one side eighteen and on the other about twenty-five miles distant, and as the consumption is variable, the pressure at the city can not be given. Greater pressure might be obtained at the wells, but this would increase the liability to leakage and bursting of pipes. For the prevention of such casualties safety-valves are provided at the wells, permitting the escape of all superfluous gas. The enormous force of this gas may be appreciated from a comparison of, say, 200 pounds pressure at the wells with a two-ounce pressure of common gas for ordinary lighting. The amount of natural gas now furnished for use in Pittsburg is supposed to be something like 25,000,000 cubic feet per day; the ten-inch pipe now laying is estimated to increase the supply to 40,000,000 feet. The amount of manufactured gas used for lighting the same city probably falls below 3,000,000 feet. About fifty mills and factories of various kinds in Pittsburg now use natural gas. It is used for domestic purposes in two hundred houses. Its superiority over coal in the manufacture of window-glass is unquestioned. That it is not used in all the glass-houses of Pittsburg is due to the fact that its advantages were not fully known when the furnaces were fired last summer, and it costs a large sum to permit the furnaces to cool off after being heated for melting. When the fires cool down, and before they are started up again, the furnaces now using coal will doubtless all be changed so as to admit natural gas. The superiority of French over American glass is said to be due to the fact that the French use wood and the Americans coal in their furnaces, wood being free from sulphur, phosphorus, etc. The substitution of gas for coal, while not increasing the cost, improves the quality of American glass, making it as nearly perfect as possible.

While the gas is not used as yet in any smelting-furnace nor in the Bessemer converters, it is preferred in open-hearth and crucible steel furnaces, and is said to be vastly superior to coal for puddling.

The charge of a puddling-furnace, consisting of 500 pounds of pig-metal and eighty pounds of "fix," produces with coal-fuel 490 to 500 pounds of iron. With gas for fuel, it is claimed that the same charge will yield 520 to 530 pounds of iron. In an iron-mill of thirty furnaces, running eight heats each for twenty-four hours, this would make a difference in favor of the gas of, say, $8 \times 30 \times 25 = 6{,}000$ pounds of iron per day. This is an important item of itself, leaving out the cost of firing with coal and hauling ashes.

For generating steam in large establishments, one man will attend a battery of twelve or twenty boilers, using gas as fuel, keep the pressure uniform, and have the fire-room clean as a parlor. For burning brick and earthenware, gas offers the double advantage of freedom from smoke and a uniform heat. The use of gas in public bakeries promises the abolition of the ash-box and its accumulation of miscellaneous filth, which is said to often impregnate the "sponge" with impurities.

In short, the advantages of natural gas as a fuel are so obvious to those who have given it a trial, that the prediction is made that, should the supply fail, many who are now using it will never return to the consumption of crude coal in factories, but, if necessary, convert it or petroleum into gas at their own works.

It seems, indeed, that, until we shall have acquired the wisdom enabling us to conserve and concentrate the heat of the sun, gas must be the fuel of the future.

USE OF SULPHUROUS DISINFECTANTS.

By GASTON TISSANDIER.

AMONG the most convenient and efficacious substances to be used for purposes of disinfection are sulphurous acid and bisulphide of carbon. The question of the merits of these substances and the advantages of using them was recently considered, in the "Journal de Pharmacie et de Chimie," by M. Alfred Riche, who said: "M. Dujardin-Beaumetz recently requested the concurrence of MM. Pasteur and Roux in instituting new experiments on the value of disinfectants, and has just published the results of the same in the 'Bulletin' of the Academy of Medicine. Two rooms of about a hundred cubic metres capacity were selected in the wooden barracks attached to the hôpital Cochin. The walls of these rooms, made of jointed planks, gave passage to the air through numerous cracks, although the precaution had been taken of stopping the larger ones with paper. Each of the rooms was furnished with a bed, the usual furniture, and cloths of different colors. Bromine, chlorine, and sulphate of nitrosyle were successively rejected. Three sources of sulphurous acid were experi-

mented upon—the combustion of sulphur, liquefied sulphurous acid, and the combustion of bisulphide of carbon. The room was closed for twenty-four hours. Tubes containing culture-infusions sowed with different proto-organisms, especially the comma microbe described by Koch, were placed in rooms, together with tubes containing vaccine lymph. After each experiment the tubes were taken to M. Pasteur's laboratory, and there compared with other tubes used as tests. The process of the combustion of sulphur is the simplest and cheapest. To perform this combustion, it is sufficient to set on the floor a sheet-iron plate—a large potsherd on the ground gives a satisfactory result—on which is placed a furnace of bricks and mortar, or better, one of those small, nearly square furnaces of fire-clay recommended by M. Pasteur, twenty-five centimetres long and twenty centimetres wide, and having the sides pierced with air-holes. To obtain a complete combustion of the flowers of sulphur, it is necessary to

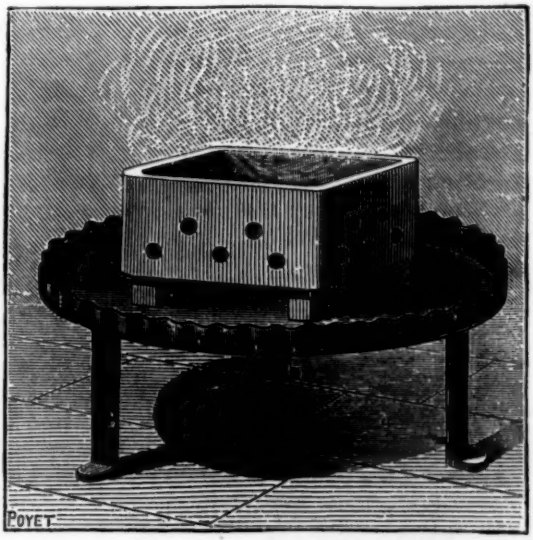

FIG. 1.—BURNER FOR SULPHUR.

take care that the whole surface be evenly burned; this may be effected by wetting the sulphur with alcohol and inflaming the alcohol. By this method we can burn completely and absolutely as large a quantity as forty or fifty grammes per cubic metre of flowers of sulphur. With twenty grammes per cubic metre, all of the culture-infusions experimented upon were sterilized, except the one containing the carbuncular (anthrax) bacteria. The activity of the vaccine virus was destroyed. The only probable inconveniences involved in the application of this economical process arise from the danger of fire in case the furnace is badly constructed, and from the liability of the metallic objects that may be present to be tarnished. This may take place

from particles of the burning element flying around the room, and, settling on articles of copper and iron, covering them with a sulphurous coating.

"The process of using liquid anhydrous sulphurous acid in siphons is free from these inconveniences. The siphons contain 750 grammes of the acid, and one of them is efficient for the disinfection of twenty cubic metres of space. In using the siphons a vessel is set in the middle of the room, and is put in communication with the outside by means of an India-rubber tube passing through a hole in the door. The door having been closed, the orifice of the siphon is inserted into the India-rubber tube, and, the liquid being let in through it, is freely evaporated in the air of the room. This process is very convenient; it avoids the danger of fire, and does not affect metallic objects; and the penetrative force of sulphurous acid thus administered appears to be greater than that of the acid obtained by burning sulphur. The only drawback to its use is the high cost. The siphons are sold to the general public for a dollar each, but can be bought in large quantities for half that price. Thus the expense of disinfecting a room of one hundred cubic metres with this preparation would be from two and a half to five dollars."

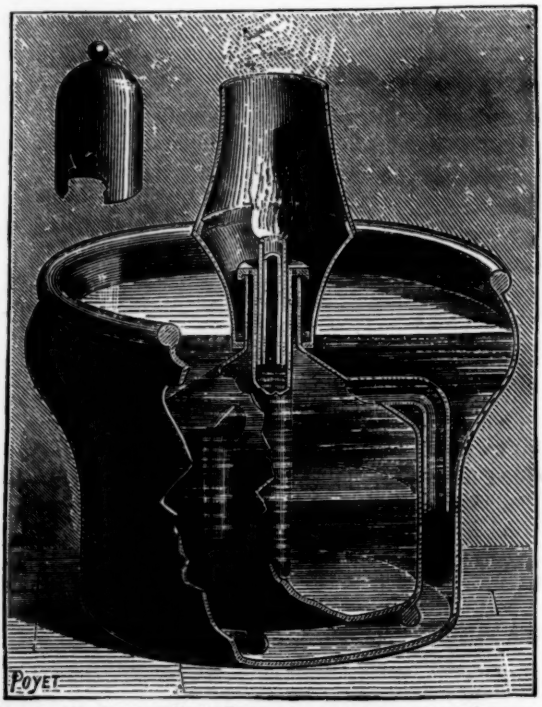

FIG. 2.—M. CKIANDI BEY'S BURNER FOR BISULPHIDE OF CARBON.

The process of the combustion of bisulphide of carbon was sug-

gested by M. E. Peligot; and all danger in employing it is obviated in the new burner invented by M. Ckiandi Bey, engineer. This apparatus is illustrated, with a view of its interior arrangement, in Fig. 2; and a more detailed explanation of its parts can be obtained from the examination of Fig. 3.

M. Ckiandi's burner is composed of an exterior receiver of tinned copper, A B C D, containing an interior vessel, I H E F, to the sides of which are fixed three siphons, R S. To put it in operation, the cylindrical tube, K L M N, is placed in the interior vessel; sulphide of carbon is poured in up to the level *a a*, and the exterior receiver is then filled with water up to the level *b b*. By means of the siphons the water

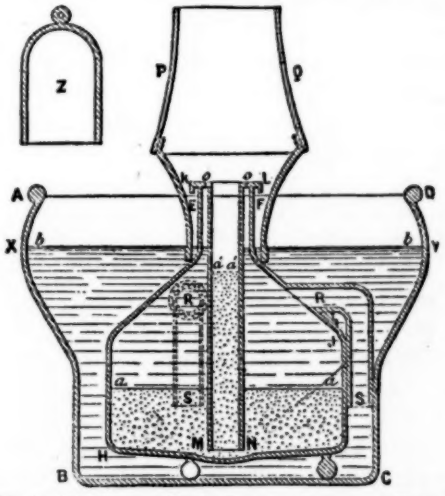

FIG. 3.—M. CKIANDI BEY'S BURNER, SECTIONAL VIEW.

penetrates into the interior vessel, presses upon the sulphide of carbon, which is heavier than it, and drives it in the interior tube up to the level *a' a'*, where it is taken up by a cotton wick, which is lighted. The upper end of the tube is crowned with a chimney, P Q, to facilitate the draught. The combustion of the sulphide of carbon may be increased or slackened at will by raising or lowering the level, *b b*, of the water in the external receiver; and this facility will be found of advantage in many cases.

The burner is placed in the room to be disinfected and lit, when the room is evacuated and shut up tight. When all the sulphide of carbon has been burned, its place is taken by water, and the lamp goes out of itself; in the mean time the burning goes on with great regularity, and without any danger. About two and a half kilogrammes (six and a quarter pounds) of sulphide of carbon are sufficient for a room of a hundred cubic metres. The process is effective and economical enough; for sulphide of carbon is sold commercially for fifty centimes (about ten cents) per kilogramme, which gives about twenty-five cents

as the price of disinfecting a room of a hundred cubic metres. The burner costs ten dollars, but it will last for a very long time. This process is evidently practicable and convenient. It does not tarnish metallic objects, and furnishes a continuous, slow, and regular disengagement of the disinfecting gas.—*Translated for the Popular Science Monthly from La Nature.*

THE MEDITERRANEAN OF CANADA.

By J. MACDONALD OXLEY.

IN the month of February last a report was laid before the Parliament of Canada detailing the results of an expedition dispatched by the Government of that country particularly for the purpose of inquiring into the navigability of Hudson Strait and Bay, and, at the same time, of gathering information concerning the resources of that region, and its availability as a field for settled habitation. This report represents the first properly organized attempt that has ever been made to pierce the secrets of Hudson Bay for the public benefit.

It is at first blush not easy to understand why this mighty expanse of water, occupying the peculiarly important position that it does, should remain for so many generations comparatively unexplored, and wholly unutilized, except as a hunting-ground for a few New Bedford whalers, or a medium of easy communication between some half-dozen scattered factories of the Hudson Bay Company. Although called a bay, it is really an inland sea, 1,000 miles in length by 600 in width, having thus an area of about 500,000 square miles, or quite half that of the Mediterranean. It drains an expanse of country spreading out more than 2,000 miles from east to west, and 1,500 from north to south, or an area of 3,000,000 square miles. Into its majestic waters pour feeders which take their rise in the Rocky Mountains on the west and in Labrador on the east, while southward it stretches out its river-roots away below the 49th parallel until they tap the same lake-source which sends a stream into the Gulf of Mexico. Despite its distance northward, its blue waves are never bound by icy fetters, and its broad gateway to the Atlantic is certainly navigable four months out of the year, and possibly all the year round to properly equipped steamships. Its depths abound in finny wealth, from the mammoth whale to the tiny caplin. Its shores are serrated by numerous streams, some navigable for long distances inland, and all stocked with the finest of fresh-water fish, and clothed as to their banks with valuable timber ready for the lumberman's axe. Its islands are rich in mineral ore of many kinds. The country whose margin its tides lave is well adapted for tillage and pasturage, while all around the region swarms with animals and birds

whose flesh or fur renders their chase a highly lucrative employment. How comes it, then, that, for all this superabundant endowment, the only population outside the wandering bands of Eskimos and native Indians to be found there to-day gathers in little circles around the company's forts which dot the shore at immense intervals?

The explanation of this apparent enigma is not far to seek. It lies simply in the fact that, until little more than a decade ago, Hudson Bay and vicinity was the subject of a monopoly, which effectually excluded from it all but the employés of a single corporation. It was first visited in 1610 by Henry Hudson, who, after giving his name to the Hudson River, in his rude little bark, well named Discovery, dauntlessly pushed his way thither in search of the mythical northwest passage to the Pacific, and made it both his imperishable monument and his grave. The stories that his mutinous crew took home with them did not prevent other vessels being dispatched on the same hopeless quest, and, if these latter failed to find the northwest passage, they at all events found sufficient cause for the Hudson Bay Company being founded in 1668. This astute corporation, easily obtaining a grant of the bay and its environing territory, together with the most extensive powers from a king who knew nothing of its value, and cared less, forthwith set about excluding all possible rivals from their invaluable fur-preserve. For half a century or more they had a serious obstacle to the execution of their laudable design in the presence of the French, and the bay became the theatre of many a hard-fought conflict.

It was not until, by the Treaty of Utrecht in 1713, the whole of Hudson Bay was ceded to the British, that the company were left to the undisputed possession of their vast estate—the most stupendous landed property ever owned by one corporation, embracing, as it then did, the entire Northwest of Canada. As the day for violence had gone by, they resorted to a subtler but incomparably more effective method of keeping the country to themselves. The most ingeniously false and distorted accounts were sedulously spread abroad concerning this region. According to them, it was a land of eternal snow and ice, utterly unfit for human settlement. The perils of the passage through the strait were grossly magnified. Preposterous tales were circulated as to the rigors of the climate, the fierceness of the wild animals, and the barbarous character of the inhabitants. The company's efforts were crowned with the most gratifying success. Decade after decade slipped by, and they were still in unquestioned possession, and probably would have continued so to this day, but for their having been bought out in 1870 for the tidy sum of £300,000, by the Canadian Government, to whom, with some reservation, they transferred all their real estate.

With the change of ownership came a complete change in policy. Under the new *régime*, the great object held in view was no longer to keep the country a solitude, unbroken by the hum of human life, but

to ascertain in how far it might be available as a field for settlement. In fulfillment of this policy, Dr. Bell, Assistant Director of the Geological Survey, was sent up there with an exploring party for six successive seasons, and his observations constitute some of the most interesting portions of the reports of that survey. The vast importance of this region rapidly dawned upon the public mind, when it became known that here was an immense range of country, having a temperate climate, a fertile soil, and boundless wealth in forest and mine, awaiting the long-delayed advent of the farmer, the lumberman, and the miner. And not only so, but the phenomenal development of the great Northwest drew attention to Hudson Bay upon another and even more immediately important ground.

Entering as this bay does into the very heart of the continent, and being connected by navigable rivers with a network of great lakes which spreads out until it touches the western boundaries of Manitoba, the keen-eyed farmers of that fertile province espied in it a hopeful solution of the vital problem how they should most cheaply transport their grain to the markets of the Old World. By reference to a map of the northern hemisphere it will at once be seen that the shortest possible route between the Northwest Territories and Europe lies through Hudson Bay. As the result of careful calculations, it has been ascertained that even the city of Winnipeg, which is situated in the extreme southeastern part of these Territories, is at least eight hundred miles nearer to Liverpool, for instance, by the Hudson Bay route, than by the St. Lawrence, while the difference in favor of the former necessarily increases the farther we advance northwestward. If, as Dr. Bell has so clearly pointed out, we take the central point of the agricultural lands of the Northwest, we shall find that the distance from it to Winnipeg is about the same as it is to Churchill, the finest harbor in Hudson Bay. Now, the distance between Churchill and Liverpool is a little less (about sixty-four miles) than it is between Montreal and that great entrepot of commerce. The conclusion consequently is that, as between the above-named center and Liverpool, there is a saving of the whole distance from Winnipeg to Montreal by the use of Hudson Bay. This saving amounts to no less than twelve hundred and ninety-one miles by way of Lake Superior, and sixteen hundred and ninety-eight miles *via* Chicago.

The translation of miles into dollars and cents is an easy process nowadays, and it has been estimated that the difference in freight in favor of the Hudson Bay route is at least thirty-two cents on each bushel of grain, or, in other words, means an additional profit of over six dollars an acre to the farmers of the West. When this idea had once fairly taken hold of the public mind, a profound interest was awakened, not only throughout Canada, but also in England, where, at the 1880 meeting of the British Association, Sir J. H. Lefroy, President of the Geological Section, hesitated not to affirm that the natural

seaports of that vast interior now thrown open to settlement, Manitoba, Keewatin, and the other provinces yet unborn, must be sought in Hudson Bay. The mouth of the Churchill River would undoubtedly be the future shipping-port for the agricultural products of the Northwest, and the route by which immigrants would enter the country. In Canada the subject was brought before Parliament for the first time in 1878, and thenceforth pressed upon its attention every year, until, finally, after a committee had gathered all available information upon the subject, it was decided, at the session of 1884, to dispatch a fully equipped expedition having for its main object the determination of the one point upon which the whole question rested, namely, whether the bay and strait might be relied upon as safe and serviceable highways of commerce. It was, of course, a matter of general knowledge that these waters had been plowed by keels for two hundred and seventy-four years back; that sailing-vessels of all descriptions, from the pinnace of twenty tons to the seventy-four-gun man-of-war, had passed through the strait and spread their white wings all across the bay; and that Moose Factory had been visited by a supply-ship with unfailing regularity every year since 1735. But facts like these, encouraging as they might be, were not conclusive, because in all cases these vessels had been free to choose their own time for entering and leaving the bay, and they therefore still left the question open as to whether these waters were navigable during a sufficient portion of the year to render possible the development of a great and permanent commerce. In order that there should be successful shipping-ports upon the bay, there must, of course, be railways leading from the interior to these ports, and these railways must be assured of a profitable volume of business during a good long season, or they would never be built. The expedition, therefore, was charged primarily with the duty of affixing the limits of the period of navigation, and at the same time was instructed to gather as much information concerning the climate, resources, flora, fauna, and other features of the region as the limited time at its command would permit.

On the 22d of July last the steamship Neptune, a wooden vessel, built and equipped with special reference to northern navigation in prosecution of the seal-fishery, set forth from the port of Halifax, with the members of the expedition on board. These were some twenty-six in number, Lieutenant Andrew R. Gordon, R. N., of the Meteorological Survey of Canada, being in command, and having with him, in the double capacity of geologist and medical officer, Dr. Robert Bell, whose explorations in the vicinity of Hudson Bay have been already referred to. The rest of the party comprised a photographer, eight observers, three carpenters, and twelve station-men. As the observers and station-men were to be left for the winter, they had each of them been carefully examined by medical authority, and pronounced physically well fitted to withstand the rigors of an Arctic climate.

Sailing up past Capes North and Ray, and thence through the Gulf of St. Lawrence and the Strait of Belle Isle, the Neptune coasted along the Labrador shore until reaching Nain on the 29th, where a pause was made in the hopes of securing fur clothing for those who were to remain out all winter, and also an interpreter. Failing in both objects, but experiencing much kindness at the hands of the Moravian missionaries, one of whose principal stations Nain is, the expedition continued on to Nachvak, arriving there on the 1st of August. On the way icebergs were encountered in great numbers, requiring constant vigilance on board the steamship. At Nachvak, which is a post of the Hudson Bay Company, both the fur clothing and the interpreter were readily obtained. The company's agent informed Lieutenant Gordon that the ice takes over the harbor of Nachvak, which is in latitude 59° 10′ north, and longitude 63° 30′ west, about the middle of November in each year, and, curious to note, has, for the last seven years, at all events broken up within a day of the 26th of June in each year. Off Cape Chudleigh, which is just at the mouth of Hudson Strait, the Neptune was enveloped in a dense fog, which compelled her to lay-to from Sunday until Tuesday morning. Tuesday, however, dawned bright and clear, and, pushing in through Grey Strait, a fine harbor was found that afternoon on the north-western shore of the cape, at the entrance to Ungava Bay. On the shore of this harbor a site was selected for observing station No. 1, and the place named Port Burwell, in compliment to the observer appointed to that station. As the best and briefest method of indicating the precise nature of the duties devolving upon these observers who were to spend a long and dreary winter at their posts, we herewith transcribe the instructions with which each was furnished :

Instructions to Officers in charge of Stations in Hudson Bay and Strait.—As the primary object of the whole expedition is to ascertain for what period of the year the strait is navigable, all attention is to be paid to the formation, breaking up, and movements of the ice.

Each station is supplied with a sun-dial and time-piece, and the clock is to be tested each day when there is sunshine about noon. A table of corrections is supplied for the reduction of apparent time to local mean time ; to this the difference of time will be applied to 75th meridian, all entries being made in the time of this meridian, and observations will be taken regularly at the following times throughout the year, viz., 3h. 08 m., 7 h. 08 m., 11 h. 08 m., A. M. and P. M.

Each morning the sums and means of the observations taken on the previous day will be taken out and checked over ; they will then be entered in the abstract-books supplied for the purpose.

After each observation during daylight the observer on duty will take the telescope and carefully examine the strait, writing down *at*

the time all that he sees, stating direction and (when possible) velocity of tide, movement of ice, if any; also describe the condition of the ice, whether much broken up, solid field, etc.

Tidal Observations.—Each day the time and height of high and low water are to be carefully observed, and during the open season the character of the tide will be carefully noted for two days before and three days after the full and change of the moon. For this purpose a post, marked off in feet and fractions of a foot, is to be placed in the water, at low water in some sheltered spot, if any such be available, and the height of the water noted every half-hour during the rise and fall of one tide on each of these days—the height to be noted most carefully every five minutes during the hour of high water and the same at low water; the five-minute observations will also be taken for one hour during the most rapid portion of the rise. Special observations of barometric pressure are to be taken in connection with these tidal observations.

To check the zero-mark for the tidal-observation post, select a spot on shore from which the horizon line will be projected on the tidal post, and record the reading of this line when seen projected on the post by the observer, whose eye is to be placed at a measured height above the datum-point selected on shore.

All remarks in regard to the movements of birds, fish, etc., and also as to the growth of grasses, will be carefully entered.

As it is impossible to give to the officers in charge of stations detailed instructions which would be of service in every contingency which might arise, the officers are required to observe and enforce the following rules:

(*a.*) Every possible precaution is to be taken against fire, and, as it is anticipated that the temperature can be maintained considerably above the freezing-point inside the houses, two buckets full of water are always to be kept ready for instant use.

(*b.*) As the successful carrying out of the observations will, in a great measure, depend on the health of the party, the need of exercise is strongly insisted on during the winter months, and also that each member of the party shall partake freely of the lime-juice supplied.

(*c.*) Each party is supplied with a boat, but, unless some emergency requires it, it must be a rule that neither afloat nor ashore must any of the party leave the station for a greater distance than they can be sure of being able to return the same day.

(*d.*) As soon as possible after the houses are completed and the stores all in place, the party will set to work collecting sods, grass, or any other non-conducting material, and before the winter sets in the whole house is to be covered with this, boards overlaid, and snow packed over all; the assistance of the Eskimos should, if possible, be obtained, and the whole house arched over with snow.

As will be gathered from the above, the observers' duties, while not onerous, were sufficiently varied and responsible to impart variety and purpose to the otherwise necessarily monotonous and depressing round of existence.

It was intended to place station No. 2 on the lower Savage Islands, at the northern entrance to the strait, and nearly opposite to station No. 1, but a succession of stormy weather prevented success in doing so. The expedition proceeded up the strait to Big Island, North Bluff, where station No. 3 was established, and the place christened Ashe Inlet. The Eskimos in the neighborhood seemed highly delighted at the prospect of having white men near them. Station No. 4 was established at Stupart's Bay, Prince of Wales Sound, across the strait from Ashe Inlet; station No. 5 at Port de Boucherville, Nottingham Island. Other calls were made at Digges Island, near Cape Wolstenholme; at Marble Island, south of Chesterfield Inlet, which was found marked by the presence of nineteen graves and a monument to six other persons who had been drowned; at Churchill, the future Liverpool of the region; at York Factory, the present commercial metropolis of the bay, whence, after a stay of only one day, the return journey was taken up. The several stations were visited in turn, and the finishing touches were given to the preparations for the long Arctic winter. A second attempt was made to establish a station on Resolution Island. Two bays were examined, in both of which the vessel ran unwarned immediately from deep soundings upon the rocks, and the idea was given up. Finally, the Neptune arrived at Port Burwell, on the 27th of September, where, as at all the other stations, it found the observers well, pleased with their work, and satisfied with their provisioning. Thence the expedition returned to St. John's, Newfoundland, where the Neptune was given up to her owner, while the men took passage for Halifax.

The course of this expedition having thus been briefly outlined, it now remains to examine into the results so far as they have been detailed, and consider their bearing upon the important problem sought to be solved; and, first of all, with regard to the navigation of Hudson Strait and Bay. The ice has hitherto been supposed to be the most formidable barrier to the navigation of these waters, but Lieutenant Gordon assures us that under investigation its terror very largely disappears. The ice met with during the cruise of the Neptune could be divided into three classes—each class having a distinctly separate origin—namely, icebergs from the glaciers of Fox Channel, heavy Arctic ice from the channel itself, and ordinary field-ice, being that formed on the shores of the bay and strait. No icebergs were encountered in Hudson Bay, nor were any reported as having been seen there in the past; but in the strait a good many were seen, principally along the northern shore, where a number were stranded in the coves, while others were met with in mid-channel. Of those seen in the eastern

end of the strait, some had undoubtedly come in from Davis Strait, passing between Resolution Island and East Bluff; but all of those met to the westward had come from Fox Channel, as observations made by the observer at North Bluff show that an iceberg coming in sight from the westward will pass out of view to the eastward in from three to four tides, showing an easterly set of upward of ten miles a day. In Lieutenant Gordon's opinion, the icebergs seen in Hudson Strait during August and September would form no greater barriers to navigation than do those met with off the Strait of Belle Isle, nor were they more numerous in the former than they frequently are in the latter waters. The field-ice encountered, although it would have compelled an ordinary iron steamer to go dead-slow, gave no trouble to the Neptune, the vessel running at full speed between the pans, and rarely touching one of them.

In the harbor at Ashe Inlet the ice came in with the flood-tide, and set so fast that the Eskimos were able to walk off to the ship, although she was at least three quarters of a mile from the shore. On the south shore, also, it was much the same; but still no ice was met with through which the steamer could not easily and safely force her way. In the center of the strait, to the east of North Bluff, no field-ice was seen at all, while between Stupart Bay and Salisbury Island long strings of ice were frequently seen; but, as their direction was invariably parallel to the vessel's course, it was only necessary to coast round them. On the homeward voyage none of this field-ice was seen at all. It is a point of no small significance that, upon the testimony of the Eskimos, both at Ashe Inlet and Stupart Bay, the quantity of ice in the strait had been very unusual that year, and the ice had never been known to hang to the shores so late in the season.

After passing the east end of Salisbury Island the ice got heavier and closer, and when off Nottingham Island the pack was so run together that no attempt was made to force the ship through it. Viewed from a hill on Nottingham, the sea in every direction seemed one vast ice-field, in which four vessels could be noted fast prisoners. This ice was of an altogether different type to that which had been hitherto met. In some cases there were sheets of solid blue ice not less than forty feet in thickness, not a mere aggregation of field-ice, but evidently frozen just as it stood. In other places the thickness would be twenty feet, and the general average of the whole field at least five feet. Now, the question as to the origin of this ice, and whether it will be frequently met with in the strait, is one of paramount importance. Lieutenant Gordon does not consider it possible for ice to form in Fox Channel to a greater thickness than ten feet in a single year, and consequently feels convinced that much of the ice encountered was the accumulation of several years. Ice is well known to be a very poor conductor of heat, and therefore, when once a certain thickness has been formed, the subsequent rate of thickening must be very slow.

The depth to which water will freeze has never yet been determined; but measurements of the formation of ice which are to be carefully made at the observing-stations will, no doubt, materially assist in a determination of this important question.

At Churchill the harbor-ice forms, on an average, about the middle of November, and breaks up about the middle of June, and these two dates may therefore be taken as marking the extreme limits of the season during which that harbor may be used.

With regard to the time consumed in making the passage through the strait, it is necessary to note that, had the Neptune gone direct from Cape Chudleigh to Churchill, instead of coasting and working across the strait, there would have been no greater delay on account of the ice than forty-eight hours at the most; but, at the same time, no ordinary iron steamship, built as the modern freight-carrier is, could have got through the heavier ice without incurring serious risk, if not actual disaster.

There is one matter to which Lieutenant Gordon draws attention that will require the serious consideration of mariners navigating these waters, namely, that in working through the strait, especially at the western end, he found the ordinary compass so sluggish as to be practically useless. The Sir William Thomson card, however, worked admirably when properly compensated. The reason of this difficulty with the ordinary compass is that, from the proximity to the magnetic pole, the horizontal directive force of the earth's magnetism, which alone directly affects the compass-needle, is very small compared with the whole magnetic force, and consequently the effect of induced magnetism in the iron of the ship on the compass becomes very large in comparison with the direct action above mentioned, the result being that, in an imperfectly compensated compass, the error due to local attraction is very greatly increased. The means of correcting this error in the Sir William Thomson binnacle are perfect and easily mastered, and the system is such that the compass can, after the first voyage or two, be perfectly compensated by using certain proportions of soft-iron bars and magnets as correctors, the proportion having to be determined by actual observation and experiment on the voyage. All steamships making the voyage through the strait, Lieutenant Gordon therefore concludes, should have one of these compasses as a standard, and the captains should familiarize themselves with the methods of correcting them, and, as opportunity offers, take azimuth observations, both stellar and solar.

Great caution will have to be observed by all vessels approaching the strait in thick weather, owing to the strong southward current there prevailing, which, during the forty-eight hours the Neptune was lying-to, swept her forty miles out of her course by dead-reckoning, showing that the amount of southerly set exceeds that indicated by the Admiralty directions. Then, again, the tides rise to a consider-

able height, as much as thirty-two feet at springs in some places, and in their fluctuations create tide-races, which have to be taken into consideration and carefully allowed for. Thus at the entrance to Churchill there is a tide-race, the velocity of which was estimated to be not less than seven knots.

In the matter of weather, Hudson Strait would seem to compare very favorably with that great highway of commerce, the Strait of Belle Isle, as the following table, which is for the month of August, clearly indicates:

	Belle Isle Strait.	Hudson Strait.
Number of days on which fog is recorded	13	9
Approximate number of hours of fog	220	102
Days on which snow fell	0	4
Days on which rain fell	10	8
Days on which wind exceeded twenty-five miles per hour, but did not reach forty	6	5
Days on which wind exceeded forty miles	2	1

This is a very favorable showing for Hudson Strait, and it is strengthened by the annexed table, affording a comparison between Station No. 1 at Cape Chudleigh and Belle Isle. This table covers the month of September:

	Belle Isle Strait.	Hudson Strait.
Number of days on which fog is recorded	7	4
Approximate number of hours of fog	82	34
Days on which snow fell	3	8
Days on which rain fell	15	6
Days on which velocity of wind was between twenty-five and forty miles per hour	4	5
Days on which velocity of wind was forty miles or over per hour	11	3

So far as weather is concerned, therefore, Hudson Strait enjoys a decided advantage over Belle Isle Strait, and on that ground, at all events, presents no difficulties of such a character that they can not readily be overcome by experienced, careful navigators.

Those portions of Lieutenant Gordon's report which deal with the resources and trade of the region he visited, interesting and important as they are, must be passed over for the present, while we hasten on to what he has to say concerning its natural history. Before doing so, however, it is worth noting that, although Hudson Bay belongs to Canada, its whale and walrus fisheries have been hitherto enjoyed by the Americans altogether, and the fur-trade has been entirely monopolized by the Hudson Bay Company, so that the Dominion practically obtains no benefit from these vast possessions whatever. Lieutenant Gordon accordingly, very properly, presses upon the Government of Canada the necessity of their turning their attention to this unaccount-

ably neglected field for enterprise and investment, and especially of seeing that its treasures are not prematurely exhausted, but so preserved as to be a permanent source of revenue and profit.

We come now to Lieutenant Gordon's observations upon the natural history of the country, and first of all as to its human inhabitants. These are very scanty, and, with the exception of a few white men at the traders' posts, are solely Eskimos. On the north side of the strait they are quite familiar with the ways of white men, and seem to be highly pleased at the prospect of increased intercourse with them. Occasionally one is met with who has mastered the English tongue, but not often. Many others understand well enough what is said to them in that language, although they can not be persuaded to speak it. They are particularly fond of any article of civilized clothing, and the head-man at North Bluff manifested no small pride at the possession of a stand-up linen collar, which he displayed to the utmost advantage. In character they are docile, amiable, and willing to work. When landing the stores and coal at North Bluff they worked all day along with the men, carrying heavy weights up over the rocks, and toiling away as cheerily and heartily as could be desired, asking no other remuneration than biscuits, of which commodity they are inordinately fond. These people have no farinaceous food of any kind, and, as a consequence, the children are not weaned until they reach the age of three or four years. The families are small, there rarely being more than two or three children, and, although early marriages are the rule, their numbers must be diminishing, because signs of their presence were met with everywhere, while the people themselves were found at only three places along the straits, and there are only some five or six families known to be between Cape Chudleigh and Nachvak. Along the Labrador coast the Eskimos gather in small settlements around the Moravian mission-stations. Nain is considered the largest settlement, and its Eskimo population does not exceed two hundred souls. Those at the stations are all educated, being able to read and write in their own language, and, according to the missionaries, are regular attendants at church, and very fond of music—two excellent and hopeful traits certainly.

Practical prohibition prevails, thanks to the vigilance of the missionaries, and the only liability to temptation that ever falls in the way of an Eskimo is when some unprincipled Newfoundland fisherman offers him a pull out of his flask. This, however, is a rare occurrence, and there is no record of any disturbance or trouble ever having been raised that would elsewhere demand the presence of a policeman for its quelling. The missions are so well managed as to be self-supporting, the *modus operandi* being for the missionaries to supply the Eskimos on loan with the very best traps, fishing-lines, and other gear, and then to purchase from them all their catch, whether it be seals, cod, salmon, furs, or anything else. A vessel which comes out from

London every year transports the stock thus accumulated to London, where it is sold for the benefit of the mission, and in this way a considerable income is secured annually. In reference to the work thus carried on by the missionaries, Lieutenant Gordon pays them a well-deserved compliment by giving it as his opinion that their system of dealing with the natives, when honorably carried out, as it has been, and is on the Labrador coast, is the one which best meets the wants of the natives, and tends to the improvement of their condition.

So much has been said by Arctic explorers about the incorrigible kleptomania of the natives they encountered, that we read with no less surprise than gratification this testimony as to the moral condition of the Eskimos at Hudson Strait: "One word may be said in regard to their honesty. Although scraps of iron and wood possess a value to them which we can hardly appreciate, they would take nothing without first asking permission; not even a chip or broken nail was taken without their first coming to the officer who was on duty at the building for permission to take it."

In the matter of animals, the Hudson Bay region is quite as scantily supplied as it is in human inhabitants, the list of terrestrial mammalia comprising only four species, namely, the polar bear, the fox, the hare, and the reindeer. The skin of the polar bear is quite valuable, a good one bringing twelve dollars with the agents of the Hudson Bay Company. These animals, although reported by the Eskimos to be very savage, will not, as a rule, attack human beings unless first wounded or rendered desperate by hunger, under which circumstances any beast of prey becomes an undesirable neighbor. The Eskimos on the south side of the strait stated that, at certain times of the year, there were large numbers of these animals seen. Their meat is not unpalatable, but the liver is said to be poisonous. Of foxes there are three kinds found, to wit, the white, the blue, and the red. The white species would seem to be very numerous, judging from the number of skins seen with the natives. These skins, however, have no commercial value. The blue fox is properly of a steel-gray color. The skins are in good demand; but the animals are not at all numerous. As to the red fox, its sole value consists in the fact that its presence indicates the possibility of that most precious of all pelts—a black fox's—being somewhere in the vicinity. This species is met with on the south side of the strait, and black foxes are annually shot or trapped in the country south of Cape Chudleigh. The most important and beneficent of all the animals of the country, however, is the reindeer, which furnishes food and clothing, and much more, too, for its Eskimo master. The hare is common over the whole coast, and with game-birds of many kinds—geese, swans, duck, and ptarmigan—will no doubt furnish many a toothsome dish for the tables of the men at the various stations.

Having thus traversed the whole ground sought to be covered by the expedition, Lieutenant Gordon brings his admirable report to a

close with some suggestions to the Government as to what should be done during the coming season. While much, no doubt, will be learned from the observations taken during this winter as to the formation and breaking up of the ice and generally in regard to its movements, and also of the other phenomena affecting navigation, it would be manifestly impossible to state definitively from one year's observations what the average period of the navigability of the strait might be. In order to do this, the stations should be maintained for a second or even a third year.

The question, therefore, as to whether the navigable season of the strait is sufficiently long to permit of an extensive commerce growing up and being profitably maintained, remains still an open one, and must do so for perhaps a year or two more. Yet, in view of what has been already ascertained, it certainly seems as if the probabilities were all in favor of the Hudson Bay route being found practicable, and pressed into the world's service at no very distant day.

The era of sailing-vessels is rapidly passing away. The freight-carriers between the continents will ere long be exclusively steamships, and to steamships properly adapted for the work the passage of Hudson Strait has been clearly shown to be perfectly feasible and free from danger. The matter has resolved itself down to this single point: For how many months may a steamship navigate those waters? And even if the answer, deduced from the observations taken at the stations now established, be that these months are too few to make the route pay, Lieutenant Gordon's expedition will not have been undertaken in vain, for it has thrown a flood of light upon a region hitherto comparatively unknown, and has opened Canadian eyes to the fact that here, right in the heart of their own territory, they possess sources of wealth, both in the seas and on the land, requiring nothing but a little enterprise and capital to yield the most satisfactory returns. In the bay and adjacent waters the whale, porpoise, walrus, narwhal, seal, salmon, trout, and cod are ready at the summons of hook and harpoon to make substantial contribution to the national wealth. Upon the shore and throughout the islands minerals without number and forests without limit await the lumberman and the miner.

THE WAYS OF MONKEYS.

By Dr. ALFRED E. BREHM.

SHEIK KEMAL EDIN DEMIRI, who died about A. D. 1405, and was the author of a voluminous treatise on the life of animals, relates the following story as a fact: "The inhabitants of a town called Olila, on the shore of the Red Sea, were in olden times meta-

morphosed into monkeys, in punishment for their wickedness. They had broken the Sabbath by fishing. Some of their pious fellow-citizens endeavored in vain to convey them back into the path of virtue; and, finally, when all admonitions proved useless, left the town. Returning to their homes three days later, they found, instead of their neighbors, baboons, which met them looking sorrowfully, and expressing by signs and attitude that they recognized the friends whose advice they had scorned with so dreadful a result. In his anger, Allah had inflicted a terrible sentence upon them." The writer carefully insists on the circumstance that the culprits were Jews.

The Prophet and his followers admit this metamorphosis by God's special intervention as a fact, and this fully explains the prominent part assigned to apes in all Arabic fables and tales. The early Egyptians believed religiously that some groups of monkeys were experts in writing, and, by that fact alone, equal if not superior to mankind in general. A number of apes were consequently sheltered and fed in the temples, worshiped during life, and embalmed after death. Those privileged specimens of the four-handed tribe, when first introduced into the temple, were handed a slate and pencil by the chief-priest, and humbly requested to show their right to admission into the sacred asylum by writing. The gamboling and grinning candidates wrote, and nobody ever doubted that the figures traced by their agile hands fully deserved to be classed in the category of hieroglyphs. So highly were they held in respect and veneration, that the holy Sphinx was represented with their hair-dress, and, till to-day, men and women in the country of the Mahdi give their hair the same shape. But the Egyptians never admitted that the priests or Pharaohs were the descendants of monkeys, while, on the contrary, the Hindoos built houses and temples to shelter and worship apes, and venerated the princes of their country as the direct offspring of the holy animals. The Arabs regard the latter as "the descendants of the wicked, to whom nothing is sacred, nothing respectable, nothing too good or too bad; who never feel friendly dispositions for other creatures of the Lord, and are damned by Allah, and carry the likeness of the devil and of man combined on their ill-shaped bodies."

We, the sons of civilization, agree up to a certain point with the Arabs. We also—at least that portion of modern society who have not been given an education or an overtraining in physical science—decline to see in apes anything more than caricatures of ourselves, and repudiate with much aversion the inferences drawn from Darwin's theory. On the other side, highly educated men all over the world have opened the discussion of the relationship between man and monkey, and speaking about the latter nowadays has become a dangerous task, in so far as there is but one alternative left—to offend the ancestry or the offspring! For my own part, I feel no hesitation in approaching the question of relationship to examine its

value, and in trying to illustrate the life of that pretended cousin of ours.

The apes have established their homes in every continent, Australia excepted. Warmth seems to be one of the principal conditions of their existence, as they are only found in the warmer regions. In America they are spread from 26° south to Mexico; in Asia, from the Sunda Islands to the Japanese Sea. In Europe there exists but one species of monkeys, and its members live all together in one troop on the rocks of the fort of Gibraltar, under the special care and protection of the garrison. That troop numbered in all twenty-three individuals when I visited Gibraltar in 1881.

The principal thing the monkeys claim from a country, whose clime they are enjoying otherwise, is food, plenty of varied food; and this fact fully explains the predilection they have always shown for places where pious superstition provides for their wants and makes their life comfortable.

Among other mammifers the female element wields the scepter in family life, but in the realm of apes the male is invested with the sovereign power, not by general suffrage, but by the right of force. The oldest and strongest male of a troop proclaims himself chief and leader, after having vanquished all his competitors, viz., the rest of the senior males. The longest teeth and the strongest arms decide in the question of supremacy. All those who show some reluctance to submit are chastised till they come to political reason. To the strongest belongs the crown; in his sharp teeth resides his wisdom.

This ferocious tyrant understands his duty as a leader, and performs the same with dignity. His subordinates flatter and fondle him in every way; the ladies of his harem rival in keeping his dress clean from annoying parasites. As a genuine pasha, he accepts this respect with a kind of languid acquiescence. In return, he watches carefully over his vassals, and shows a continual anxiety for their welfare and security. He orders and directs minute details in daily life, and subdues all opposition—for there exists a Left also in the monkey state—by striking and sharp bodily argumentation. As a general rule, the monkeys go early to bed, rise late, and establish their night encampment on the summit of rocks, if possible. The first thing they do in the morning is to warm themselves, for which purpose they climb to the tops of rocks and trees and turn slowly around in the sun till their hair, wetted by the nightly dew, is entirely dry. This preliminary operation is followed by a thorough cleansing of the skin, and, immediately after, by breakfast. Every eatable thing suits monkeys—fruits, onions, roots, seeds, nuts, leaves, insects, eggs, young birds, snails—and they enjoy generally a copious, free board. Their notions concerning property are very defective. "We plant and the apes harvest," says the Arab of Eastern Soudan, with his natural apathy in the presence of facts and events that he can not prevent. Does not the monkey show in

this a pronounced analogy with mankind who, since the existence of the world, though under severe penal legislation, find it so hard a task to observe the difference between mine and thine?

The hungry crowd of quadrumana infest fields and gardens: neither lock nor bolt, neither fence nor wall is an obstacle for those robbers, who steal and destroy everything in their way, whether it be eatable or not. It is not surprising, to any one who has witnessed such depredations, to see the farmers entertain a mortal hatred against these dark, grinning thieves; and the Arabs range them in the category of evil spirits. When they are surprised in their mischievous work, they flee like cowards toward the nearest trees or rocks, the mothers carrying their children. Only when flight is impossible do they show fight, and attack men as well as the biggest beasts of prey, and even elephants, with that impetuous temerity which distinguishes the coward in despair.

After a gestation of from seven to nine months, the female monkey gives birth to one young one, very seldom to twins. The new-born monkey is a little ugly creature, bare of hairs, with spindling limbs and a repulsive, senile face. But the mother is passionately fond of her monster, and caresses and nurses it with remarkable devotion. She does not leave it for a single moment, she presses it to her heart, rocks it to and fro, and takes the utmost care to keep it absolutely clean. In the first period of life the baby is apathetic and almost insensible, but begins gradually to play with urchins of its age. The mother is a patient observer of the first steps of her beloved, and watches carefully that no harm may befall it. In the mean time, she trains it; and the first virtue inculcated in the mind of the youngster is obedience, obedience in the strictest sense of the word. Men have ridiculed the maternal affection of the brute, and speak of "apish love." In our eyes the tenderness exhibited by the monkey may have a ridiculous side, but where is the man who could, without deep emotion, witness the anxiety of a mother-ape nursing her sick child? I must confess that, to my eye, in such cases she is at least the equal of the human mother. If the young ape dies, the spectacle is a piteous one. The mother can not be separated from the dead body, refuses all food, and frequently perishes from grief. In such crises the ape proves certainly his congeniality with the human race, and in his moral affections could stand as an example to many men.

The intellectual cultivation of which the monkeys are susceptible neither raises them so high above the average of mammifers, nor places them so far beneath the level of mankind, as some people contend. Further on, we find in no order of animals, as far as intellect is concerned, so wide a difference between the highest and the lowest individuals as among the monkeys, while, in inverse proportion, the lowest-gifted human creature hardly differs from the apes whose intelligence is most developed. In many instances the mental and bodily

likeness to humanity is so pronounced that the observer feels quite uncomfortable in presence of the evidently small chasm existing between man and beast.

After this general characterization of the whole species, I may be allowed to trace in large outlines the families and some of their principal representatives. Science establishes two families, the *monkeys of the Old World* and *the monkeys of the New World*, and divides the latter into two sub-families, viz., the *claw* or *squirrel apes* and the *howling monkeys*, or scientifically, the *Ouistitis* and the *Alouattes*. The home of the ouistitis extends from Mexico to Brazil. The squirrel-apes are not yet perfect monkeys, though having the same number of identically shaped teeth as the monkeys of the Old World. Their limbs end in true paws, bearing narrow, compressed, and sharp-pointed nails on the four fingers; the thumbs alone are provided with flat, large nails like human nails. They are the representatives of the transition from the unguiculated quadrupeds to the quadrumana, and rank, physically and intellectually, far below the genuine monkey with heraldic quarters. The easy, bold, and graceful movements of the latter in climbing, jumping, walking, and resting, are above their reach, and in the line of bodily abilities they hardly attain to their model, the squirrel. No one ever saw them walking in erect posture, and they always step on the full flat sole, contrary to the real monkeys, whose feet rest on the outer edge only. The cry of the squirrel-ape sounds like the whistle of mice or the pip of young birds, and its wit does not, by any means, reach the level of the genuine ape. A notorious coward, it shows all the coward's distinctive attributes—a plaintive voice, inability to submit to unavoidable facts and events, and the endeavor to swagger, even in the moment of flight.

The first rank in the family of the apes of the New World belongs incontestably to the howling monkey. Its body is slender, its limbs are proportionately developed, its hands end in five fingers, and each finger shows flat, slightly convex nails. The fur is coarse, and the hair under the chin forms a kind of long, protruding beard. A distinctive feature is to be found in a kind of bony, sixfold drum or barrel formed by an inflation of the hyoid bone, which communicates with the larynx, and gives to the voice an enormous volume and frightful sound. Hence the name of howling monkeys. The long tail is naked, callous, and of great muscular strength at its extremity, and forms a convenient prehensile organ, which might be called a kind of fifth hand, or rather the principal hand of the animal. The alouattes are not poor climbers, but they never take bold jumps, and always keep their hold by the tail till their hands have grasped the next limb, and this makes them slaves to the trees. They seldom venture upon the ground or on rocks. The howling monkeys herd in troops and follow slowly and awkwardly in the steps of their leader, whose slightest movements are imitated by every individual. There is no character in

their voice nor in their general behavior: they act like automata and yell and howl like maniacs. In the morning, when all the rest of nature is rejoicing in the new-born daylight, the troop of howling monkeys will descend gravely from the leafy tree where they have passed the night, closely gather in a huddled crowd, and, having secured some breakfast, will proceed to indulge in a kind of social entertainment which is as exempt from frivolity and impropriety as it well can be, but which well reflects the character of the participants. The company make choice of some leafless tree, which they climb with great dignity. Each member takes his place as he pleases, but one large bough is reserved for the exclusive use of the leader, who paces it to and fro, solemnly raising his tail, and begins to utter low sounds, similar to the grunt of a young hog. The prelude grows insensibly louder, the time is quickened, after a few moments the pauses are omitted, and the wretched tune, sinister at first, becomes an uninterrupted, dreadful yelling. Now the crew are thrown into raptures, and all join in one deafening cry and howl in concert. The powerful roar of the jaguar, the terrific growling of the panther, the wild shouting of a crowd of beastly, drunken rustics, lamentations, groans, seem to be combined in this chorus. And, curiously, the artists have no idea of expressing any special feeling. Such entertainments sometimes last several hours. Those long-tailed howlers are tiresome creatures, and I must confess that, in the matter of apes, the Old World takes the lead. Here, also, we find two sub-families—the *Cynopithecini* (dog-apes) and the *Anthropomorpha* (man-shaped apes). The former have perfectly developed teeth, like the quadrupeds, and a tail; the *Anthropomorpha*, on the contrary, have no tail, and their set of teeth resembles that of men, with the exception of the canine teeth, which are stronger and intermediate between those of beast and man.

The *Cynopithecini* present almost all the features in character which distinguish monkeys in general. The leadership is intrusted to the strongest male; he assigns to each member of the troop his duties, and watches for the general welfare. Their well-shaped hands give to these monkeys advantages which other animals do not enjoy, but still it is a question whether the dog could not in justice be placed on the same level with them as regards intelligence and sagacity. Apes and dogs show discernment and exercise restraint on their manner of living; both are aware that every disorderly act on their side is followed by punishment, but the apes believe themselves far above the dogs. Excessively susceptible to reproaches, they want to be praised and fondled, while they themselves tease and insult other animals at every opportunity. They are docile, they eat with knife and fork, drink from the glass, dress, ride on horseback, submit to military drilling, wait on their masters, but only when, where, and as long as they are pleased, and never with the same care and conscientiousness that characterize a well-trained dog. There is no troop in the world so hard

to manage as a troop of these monkeys, which peculiarity brings them near the hopeful youth of modern age. Another proof of their superior intellect may be found in the fact that they avail themselves of the means afforded by others to make their life as comfortable as possible.

I had often seen and closely observed individual baboons in captivity, but had never had a chance to meet those interesting animals living the life of liberty in organized troops. That pleasure was in store for me one morning, in the year 1862. I was traveling in Bogosland at the time. On the morning in question I found myself separated for a while from my companions, and had just sat down to take a short rest when I heard a kind of strange barking, coming from a steep cluster of rocks in the vicinity. Some minutes before my attention had been aroused by a number of curiously shaped forms on the summit of the rocks, but I came to the conclusion that they were large blocks of stone. The barking disabused me, inasmuch as the forms, true and genuine baboons, were now starting up. Considering the shouting of the animals as a personal provocation, I hurried up the hill and fired a shot at the troop, which at once took to their heels and were soon out of sight. About half an hour later, after I had joined my friends, we saw the same troop in file on a narrow bridge running at considerable height along a rocky wall. Another gunshot made them disappear once more, but a short distance farther, where the valley turned at a sharp angle, we met them just at the moment when they were crossing to reach the opposite hills. Our hounds, though trained to hunt hyenas, hesitated in bewilderment, but soon gave tongue and made an impetuous rush at the monkeys. At once the old males rallied and faced the dogs, forming a wide semicircle, roaring, grinning, and furiously beating the ground with their hands. Their threatening attitude and spiteful glances frightened the hounds, which recoiled in amazement. The monkeys took advantage of this momentary failure of our animals and retreated in haste. When the latter were rallied and started for a fresh attack, there were only a few more in the valley, and the last of the stragglers was a pug of about six months, which retreated in agonizing terror to the top of a large block of stone where the hounds set it. "That pug will be ours," I shouted, but was thoroughly mistaken. One of the senior males, a strong, powerful individual, started from the other side of the valley, advanced quietly toward the block, pride and mischief shining in his eyes, marched straight to the hounds, which trembled under his vicious glances and threatening gesticulations, climbed the stone, fondled the young one, put it on his back and calmly returned, while we were standing there all startled. Similar acts of self-exposure of a male are only found among monkeys, while among all the other animals, even the lions, it is always the female which risks life to save her cub.

Some time afterward I crossed the same valley in company with

Duke Ernst, of Coburg-Gotha, and near the same place we met the troop moving half-way up on the rocky slope of the hill. On the duke's motion, we resolved to offer them fight. Seven men, armed with patent rifles, opened the attack. At the first volley the females took to flight with the young ones, while the males not only did not flee, but advanced, and in less than no time a formidable hail of stones whistled around our heads. Some of the stones thrown were as large as a man's head. It was full time for us to withdraw, and so we did. The monkeys remained the masters of the battle-field.

On my second voyage to Eastern Soudan we stopped in Khartoum during the rainy season. I suffered much, even more than I am suffering here in New York, from fever and chills. In the long, tedious hours of leisure we made a collection of monkeys, and those animals cheered me up many a time in my physical and mental troubles. We played with them, and at the same time undertook their training, and that in a fashionable manner. So we gave them riding-lessons. An old, fat, lazy donkey had the honor to serve as horse, and, although the apes showed disgust and fear at first, one single lesson was sufficient to initiate them into the secrets of the noble sport, and in a few days they were, in their way, masters in the art. They would mount the donkey three, four, and five at a time, the first one embracing fondly the neck of the trotter with the fore-hands and cramping his hind-hands convulsively in the pelt of the animal's abdomen; the next one taking hold of his comrade, and securing his equilibrium in the same way by means of the hind-hands; and so on in a file. A funnier sight than this, four or five grinning apes closely nestled to the donkey's back, can hardly be imagined. The gray-haired trotter sometimes had to suffer from the mischievous riders, and did not conceal his feelings, to the great amusement of his tormentors. Besides playing, the monkeys were instructed in many little arts and tricks, and on that occasion I learned to appreciate them as smart and most sagacious creatures.

But passion makes them blind—unlike men, as it is said by the monkey-haters—as if men always kept quiet, composed, even-minded, and sober! As well as the apes in general, our baboons were passionately fond of strong liquors, and had a peculiar propensity for merisa, a kind of beer made of the grains of durrah by the inhabitants of the Soudan. Brandy was not to their taste, but, unfortunately, they made an exception one day. After having swallowed copious quantities of merisa, each one of the troop was offered a big glass of date-brandy, which he drank. As a consequence they became completely intoxicated, insolent, passionate, bestial, and grinned and gamboled in a fearful manner; in one word, they offered the hideous caricature of drunken men. The next day thirteen of the drunkards were suffering from the consequences of the spree, and looked sick unto death. All food gave them nausea; they turned away with

disgust from merisa and even from wine, a favorite beverage in ordinary time; the only things they accepted were lemons, of which each one ate an average of twenty pieces. In this wretched state they comported themselves like men, and would, doubtless, have enjoyed a sour herring if it had been possible to secure this antidote in the country of the Mahdi. In the evening they felt better, and were all right the next morning. I hoped this hard lesson would teach my pupils the advantages of abstinence, but, alas! I was mistaken once more in my life. They drank and reveled all the same, and from that day drank brandy with predilection. More than that, they claimed their rum every day as a privilege.

I took one of these baboons—it was a female—along to my home in Germany, because she had always proved to be of extraordinary sagacity, and actually exhibited a far greater intelligence than the average of the countrywomen of Thuringia, where I was living. Apes in general like other creatures, provided they submit to their caressing and fondling. My baboon at first concentrated her tenderness upon the children of the village, but, to her great sorrow, found no reciprocity. Then she turned to cats and dogs, and teased and tormented them in every way. A bright pussy, which the most of the time she carried in her arms, was tired one day of her company and attempted to escape. The ape strongly objected, and the kitten, in its struggles, scratched her in the shoulder. Gravely the baboon seized one of the paws of her pet, examined it carefully, and finding, probably, the sharp claws a dangerous superfluity in so small a being, bit them all off, one by one. We sometimes tried a practical joke on her by putting a little powder near the place where she was secured during part of the day, and flashing it by means of burning spunk. When the powder flashed, she screamed and jumped back as far as her chain permitted it. But she had very early found out the connection of things; the next time we threw the burning spunk near the powder, she rushed forward, extinguished it, and quietly ate the explosive, which she probably relished on account of its saltpetrous taste.

The aptitude of the *Cynopithecini* to distinguish between cause and effect is really remarkable. They are aware when they have done wrong, and expect punishment. An old *crowned guenon*, also called *Chinese bonnet*, living in captivity, once assaulted its attendant, lacerated his arm, and cut an artery. The animal being an old offender, the master ordered it to be shot. When the man charged with carrying out the order approached the cage of the ape, the latter, apprehending his fate, retreated to the adjoining shanty serving as bedroom, which communicated with the cage by a door. Neither flatteries nor tempting titbits could move him to come out from there. The man then had dinner brought and placed in the front cage as usual, and walked off. As soon as he was out of sight, the monkey cautiously crawled out, took part of the food, and jumped back to his hiding-

place. He went a second time, but found his retreat cut off, the door between the cage and the shanty having been shut. Seeing at the same moment the attendant armed with the dreadful gun reappear, the monkey understood at once that he was lost, jumped furiously at the closed door, tried to escape through every corner, and, finding that flight was impossible, lay down trembling, and awaited the deadly bullet.

The ape holds himself far above the other animals, and endeavors to make them understand it. My baboon showed her superior standing by tormenting every other animal in the house without any reason or the slightest provocation. I had an old dog whose temper had been spoiled by age, and which lived in open war with every creature in the house. My baboon picked it out as an object for her tricks. When the dog was taking its *siesta*, the ape would crawl cautiously near, seize the animal by the tail, and, jumping back, give it an awful jerk. The dog, roused from slumber, flew into a violent passion, and went howling and barking for the ape, who quietly watched him, and aggravated his excitement by patting the floor with her hands. As soon as the dog was near enough to reach her, she made a jump upon his back, and again squeezed his tail. These successive insults made the dog nearly frantic; he foamed and howled, but, the more excited he grew, the worse the monkey tormented him. Finally, the old hypochondriac, seeing the uselessness of trying to chastise the foe of his rest, marched off with his tail between his legs whenever the monkey showed her face.

The sagacity and docility of the *Cynopithecini*, wonderful as they are, can not be compared with the intelligence of the *Anthropomorpha*, especially the chimpanzee, the gorilla, the orang-outang, and others. I have closely observed several individuals of the family, allowed them to play with my children, and cared for their training and education, and have drawn astonishing results from my studies. These monkeys are creatures which one treats involuntarily like men, or at least like children. The orang-outangs are melancholic and not very sympathetic with men; the variety of the pongos, to which the chimpanzee belongs, is jovial and by far the most intelligent. Their voice is pure and plain, and, while it can not be denied that the voice of the gibbons sounds more melodious and constitutes a veritable song, that of the chimpanzee is a formal language. All the sounds are fully accentuated, and the observer soon understands the meaning of the different modulations, while children, playing with the animal, catch at once the sense of its utterances.

It is really impossible to treat the chimpanzee like an animal; his character and general behavior show so much of humanity that men are induced to commune with him in the same way as with their equals. In captivity he is perfectly conscious of his position, and subordinates himself willingly to the superior mental gifts and capacities

of mankind, but holds himself better and higher than other animals, especially than other monkeys. Paying in every instance high regard to men, he likes children if they do not tease and molest him. Sportive and humorous, he indulges in joking with men and animals. He is not only inquisitive but eager to acquire knowledge, examines carefully things strange to him, and falls into ecstasy when he has found out their purpose and learned to use them in the right way. While able to understand men and things, he is, nevertheless, modest and kindly, seldom willful, and never stubborn, although he claims what is in right due to him. Of variable temper, he is now good-humored and jolly, now sad and morose, and gives vent to his feelings as men do, but sometimes in a more passionate way.

I was once the owner of a highly educated chimpanzee. He knew all the friends of the house, all our acquaintances, and distinguished them readily from strangers. Every one treating him kindly he looked upon as a personal friend. He never felt more comfortable than when he was admitted to the family circle and allowed to move freely around, and open and shut doors, while his joy was boundless when he was assigned a place at the common table, and the guests admired his natural wit and practical jokes. He expressed his satisfaction and thanks to them by drumming furiously on the table. In his numerous moments of leisure his favorite occupation consisted in investigating carefully every object in his reach: he lowered the door of the stove for the purpose of watching the fire, opened drawers, rummaged boxes and trunks and played with their contents, provided the latter did not look suspicious to him. How easily suspicion was aroused in his mind might be illustrated by the fact that, as long as he lived, he shrank with terror from every common rubber-ball. Obedience to my orders and attachment to my person, and to everybody caring for him, were among his cardinal virtues, and he bored me with his persistent wishes to accompany me. He knew perfectly his time for retiring, and was happy when some one of us carried him to the bedroom like a baby. As soon as the light was put out he would jump into the bed and cover himself, because he was afraid of the darkness. His favorite meal was supper with tea, which he was very fond of, provided it was largely sweetened and mixed with rum. He sipped it from the cup, and ate the dipped bread-slices with a spoon, having been taught not to use the fingers in eating; he poured his wine from the bottle and drank it from the glass. A man could hardly behave himself more gentlemanlike at table than did that monkey.

He was especially engaging in his association with my children, always gentle, obliging, and tender, and they liked him as a good fellow and pretty playmate. When he was first introduced to my little girl, who was then six months old, he seemed perplexed, and observed her with astonishment, as if speculating whether that little bit of a creature was really a human being. At last his mind was

made up; he touched her cheek with one finger and then offered her his hand in friendship. My chimpanzee conversed very little with other animals; like the apes in general, he was afraid of the big ones and despised the smaller ones. He was always around us, and we, on our side, did not make any difference between him and a man.

The animal fell ill of mumps, followed by pneumonia. I had seen many sick chimpanzees, but never one of them behaved as he did. I engaged two competent physicians to take charge of him. He knew them from the first day, allowed them to feel his pulse, showed his tongue, and directed the hand of the attendant doctor to the painful swelling, which had to be cut open afterward, there being danger of suffocation. The doctors would not use chloroform, out of regard to the affection of the lungs; but, fearing the chimpanzee would not keep quiet during the operation, engaged four strong men to hold him. The sick animal did not submit to that rough treatment, but excitedly pushed the men aside, and then, without any compulsion whatever, but in compliance with the fondling words of his nurse, in whose lap he was sitting, offered his throat. The operation was performed, the ape never flinching or complaining. He felt afterward much relieved, and expressed his gratitude by pressing fervently the hands of the physicians and kissing his nurse. But his life was not spared; he died from pneumonia. Meekly and patiently he bore his long agony and died more like a man than an animal. The doctor told me that never in his life, at any death-bed, had he felt an emotion similar to that which seized him at the humble couch of the poor monkey. In Berlin, many beautiful eyes shed tears when the news of the sad end of my widely known and generally petted chimpanzee was spread.

Was the ancestor of the human race a monkey? That is the vexed question which still raises so much dust.

There is no doubt that man is not more and not less than the chief creature in the animal kingdom, and that the monkeys are his immediate neighbors; but I can not see why this fact should logically involve the assumption that our great-great-uncles were gamboling in paradise in the shape of apes. The doctrine of gradual evolution may seem trustworthy in the highest degree and beautiful from the scientific standpoint, but it is based upon a simple hypothesis, and a hypothesis is not a proof; and here I wish not to be misunderstood. Even if the physical and intellectual development and perfection of humanity throughout the succession of thousands of centuries is a fact, there is no authority for the inference that, *eo ipso*, a monkey-nest was the cradle of mankind.

Darwin's treatise on the variation of species gave rise to the ardent controversy of our days. Darwin used the wrong word. It is not "species" he ought to have said, but "varieties"; for species never interbreed with each other. Man and monkey, though belonging to the same group, represent two distinct species. There is, consequently,

a simple and irrefragable natural law refuting peremptorily the thesis of the enthusiastic propugnators of the pedigree rooting somewhere amid a grinning tribe gamboling in the wild forests of Asia or Africa. The criterion that the human race has large, round hands and blunt canine teeth would be sufficient of itself to establish the truth that no monkey-blood is pulsating in our veins; but there are more distinctive features. Men have strong, well-shaped legs, walk constantly in an erect posture, and enjoy the faculty of speech.

The monkeys rank near humanity in the general organization of the world; they show in many instances much likeness with mankind, physically as well as intellectually. But a further concession would be a denial of positive natural laws. Nay! old Adam was not a monkey, not a baboon, not even a chimpanzee!

MOTHS AND MOTH-CATCHERS.

By AUGUSTUS R. GROTE, A.M.

I.

ONE day, in the British Museum, while waiting a moment in a room where entomological specimens were exhibited, I saw two workmen bending over a case containing butterflies and moths.

"There is the Camberwell Beauty," said one, pointing out a particular example to his companion.

"Ay!" was the ejaculatory response, and the tone of that "Ay!" I am not likely to forget. It took me at once to the speaker's probably humble home, stored with treasured specimens in their boxes, pinned down low, labeled and arranged. How many hours of stormy evenings had not been pleasurably spent in sorting and debating, in setting and classifying, these downy bits of Nature's finery! From how much worse employment may not these "little beauties" have saved their owner!

There is no doubt that in England, as well as in France and Germany, the collecting of moths is a very general recreation as compared with the United States. That it is harmless is a negative praise; that a pursuit of its objects is healthful, and takes the man who works in the city out into the fresh country air, is a positive recommendation. But the labor is also instructive. Things have now changed very much since the days of Malpighi, and biology is a respected and necessary study. And throughout the world of animated beings it may be safely said that the growth and changes of life can nowhere be so easily and pleasantly observed as in the rearing of butterflies and moths from the egg. As to butterflies, it may be asserted that they are less interesting than their cousins the moths, who constitute the

elder branch of the great natural group of scaly-winged insects, or *Lepidoptera*, to which both belong. The butterflies are less numerous in species, or kinds, and more uniform in habit and appearance. These gaudy and papery-winged day-flies have their own attractions and present their own scientific problems, but in number, diversity, soft and delicate colors, and patterns and unexpected modes of life, they can not hold a candle, to speak both figuratively and appositely, to the foolish but lovely moths.

First, let us assure ourselves that by moths we do not mean clothes-moths. These terrors to the housekeeper are only of two or three kinds, and of small size, belonging to the genera *Tinea* and *Tineola;* while there are over seven thousand species of North American moths already in our catalogues, from the large and gorgeous "Regal Moth" (*Citheronia regalis*) to the "Tiny Gem" (*Lithariapteryx*), of all shades of color from gray to pink, from black to yellow, all innocent of carpet- or clothes-eating in their young larval days. To some general statements as to these, the methods of hunting and preserving them, and those who carry on the fascinating pursuit, I claim the reader's indulgence for a few pages of what I shall try to make easy and instructive reading.

It is, perhaps, unnecessary to state that moths, like plants, bear, each kind, a particular double Latin or Latinized title, as *Actias luna*, the "American Moon-Moth," or "Queen of the Night." The first name is that of the genus, the second of the species. The genus is founded on certain particular points of structure, and usually embraces a number of kinds or species which share in these particular structural features. While the genus *Actias*, for instance, is known by its thinly scaled, pale-green wings, the hind pair furnished with twisted "tails," our species *luna* differs from a number of Asiatic and African species by certain marks and peculiarities of pattern and size.

These Latin names are a source of some difficulty to lay readers and to many amateurs. Some people prefer English names by which to designate their specimens, but our species have not been known for years, as have the European moths; consequently very few have received vernacular names. The "cotton-worm" (*Aletia argillacea*), and the "army-worm" (*Heliophila unipuncta*), are, indeed, two species of moths well known for their ravages in the larval state, and which are consequently provided with vernacular names by which they are distinguished. But we have no English names for the great majority of species, which are really different in kind from their transatlantic brethren.

The introduction of common names for our moths is evidently a matter not to be forced, but to be left to itself. The rule of priority, which Linnæus appointed to govern the Latin names, can not obtain here. Some of our butterflies have received several English names, as the common "milk-weed butterfly." Some of the names for moths in

use in England are very pretty, such as the "Arches" and "Wainscots"; others are peculiar and less attractive, as the "Pugs" and "Lackies." English names for our moths will, it is to be hoped, gradually appear in our literature and come into general use. The vernacular names proposed in economic works, such as the reports of State entomologists, are often very ugly, and have nothing to recommend them. They are simple translations from the Latin in many cases, and are then quite often ridiculous. *Dubiosa* is translated *doubtful; fraterna, fraternal,* and so on; it is clear that the Latin names are much better than these. But see what lovely names they have in England for their moths: the "Kentish Glory," the "Peach-Blossom," the "Buff Arches," the "Common Wainscot." About the vernacular names for our moths must come the cooling touch of time; they can not be struck out in the heat which accompanies the coining of a Latin name for a new species. Around their cradle some tutelary divinity must hover; some old tale, like an ancient crone, must be its nurse; out of some melody, dedicate to fields and flowers, must the words be taken which are to serve as the title for the new-comer. Affection for the object, quite distinct from the passion of the scientist, must have its part in the English name, which should also be apposite and express the appearance or habit of the moth. One of the names proposed for a North American species, *Ommatostola Lintneri*, appears to fill these conditions—viz., the "Dune Wainscot." It is a reed-colored moth, found on the sandy ridges (dunes) near the Long Island beaches. Again, another species, vividly colored, black, pink, and yellow, is called the "Spanish moth," as it bears the Spanish colors. Its scientific name is *Euthisanotia timais.* It breeds in Florida, and comes up our Atlantic coast-line in summer, being often beaten into the lighthouses with the birds, during wind-storms, or simply attracted by their light.

Our species of moths east of the Mississippi are pretty well known, and all but the very small ones, the *Tineidæ* or leaf-miners, are described in different publications. What a change during the twenty-five years which have just passed, and which span my own career as a catcher of moths! When, a boy of fifteen, I tried to find out the names of some of our moths, I had great difficulty in ascertaining that there was such a science as entomology at all! At that time, even in Agassiz's museum, at Cambridge, there were not fifty kinds labeled which had been described and named in this country. Now we have about seven thousand names of known species in our catalogues, and from one to two hundred are being added to the list every year. Our new discoveries come chiefly from the West, where wonderfully beautiful species are "turned up." Arizona and New Mexico, as well as Colorado, seem to be perfect paradises for rare and lovely moths.

The reader will have seen that there are two kinds of names, the scientific and the common. Nothing, it seems to me, that will promote

popular interest in the study should be neglected; therefore I hope that pretty English names for our moths will appear and lighten the studies of many who find Latin difficult and ugly. It must be remembered, however, that when we wish to designate a certain kind of moth with precision, we are obliged to fall back upon the Latin name, and that there is a good deal of prejudice against common names by scientists, whose opinions are worthy of respect, but whose foible it is to be very exact and precise in their statements about a moth, or any object upon which they have special information, but who are otherwise as fallible as the rest of us when it comes to matters of conduct and art.

The old saying in natural history, that everything comes from an egg, holds good for moths. Nevertheless, modern science has wrought wonderful changes in our ideas on this subject since the days of Ray and Willoughby. The young are now considered as part and parcel of the old—a continuation, to some extent, of the bodies of their parents, whether we consider a moth or a man. The affinity between the seed of a plant and the egg of an animal is indeed illusory, but in some of the lower animals there is a process of reproduction allied to budding in plants. Years ago the poet Chamisso discovered the fact that the young of a lowly organized marine animal called *Salpa* did not resemble their parents. We know now that in some cases several generations intervene before the final form of the species is assumed. When we read of the discoveries in biology of Goethe and Chamisso, we see that there is some justice in the observation that it is the poet who understands Nature best. Perhaps we should rather conclude that the imagination is a quality which the naturalist can by no means dispense with. Goethe's theory of the true structure of the vertebrate skull is now accepted; Chamisso died before Steenstrup, in 1824, vindicated at least the general truth of his particular observations. A curious story is told of the first discoverer of the true nature of the coral-makers. The French Academy of Sciences would not print his essay on the subject, and persisted in the old belief that the coral was a plant.

To return to our moth-eggs. While certain flies reproduce by a sort of budding in the larval state, our moths, so far as known, all come from eggs laid by the female moth on leaves, flowers, or the branches and trunks of trees. Some are inserted in crevices of the wood itself, and the little caterpillars, when they hatch, bore into the heart of the tree upon which they feed. The "peach-borer" (*Ægeria exitiosa*) and the "plum-borer" (*Ægeria pictipes*), Bailey's "goat-moth" (*Cossus centerensis*) are examples of certain kinds of wood-eating caterpillars. The little moth-eggs, usually attached singly, sometimes in belts and clusters, vary in the length of time which elapses before they hatch after they are laid. It is difficult to assert that there is any rule in this respect, and it is certainly hard to tell when they are "addled." When they *are* "bad" and fail to give the little worm, it is often be-

cause they are "stung" by minute four-winged flies, parasites upon these tiny objects.

One of the most curious things about the laying of moth-eggs is the botanical knowledge of the mother-moth. In the dark she knows the particular trees upon which her brood flourish, out of a whole forest. The proverb about one man's meat being another man's poison holds good when applied to the caterpillars of moths. They will starve, as a rule, *before* eating, or die *upon* eating, the wrong kind of leaves. The little eggs, sown here and there by the mother-moth in her nocturnal flights, are often very pretty to look at through the microscope, being adorned with delicate traceries. Some kinds are nearly smooth, as those of the *Cecropia*, which are quite easily found on lilac and other leaves, gummed on, with a little brown spot above, over the micropyle, through which the curled-up caterpillar within, a little black, thorny creature, escapes. Some caterpillars eat the empty egg-shell for their first meal, but the practice is far from general. Some which I particularly noticed, those of the "chestnut-stripe" or honeysuckle-leaves, only nibble at the empty egg-shell, and, I thought, were attracted by some of the softer parts which might remain. The caterpillars of this moth (*Homohadena badistriga*) afterward make a rather stout cocoon; I have reared them from eggs found in the back-yard of a house in the heart of New York city. So far do our country friends penetrate.

The bodies of caterpillars and moths are made up of segments, or rings, hardened by a substance called *chitine*, so that it has been said that insects really follow out Sydney Smith's suggestion, given under exceptional circumstances, and "sit in their bones" the whole time. They strike against the outside world with the knobby parts of their anatomy. A child once described a caterpillar as a "jointed tube, filled with soft stuff." I don't know how she found out about the "soft stuff," but the insides *are* soft, and, when carefully examined, show the respiratory canals, opening by little narrow slits in the sides of the segments (for insects do not breathe by the mouth), the nervous and the muscular systems, networks of little whitish threads, as also the central digestive apparatus, which takes up the most room, as our caterpillar is principally a feeding animal. The stiffness of the rings of insects is obviated by their being connected by a highly flexible membrane. The caterpillar increases in size by changing its skin. The old covering becomes too small to hold the food which is retained and transformed by the chemistry of the body into caterpillar-flesh. It splits behind the head, and, with more or less trouble, the caterpillar frees itself from it, stepping out, and leaving its old skin, a thin and almost colorless pellicle, to be blown by the summer winds into Nature's rag-bags which the spiders mostly carry about.

Caterpillars are of all colors, and, within certain limits, of all sizes, variations of the "jointed tube, with soft insides." They are plain and smooth, or ornamented with tufts of hair, or fleshy, colored humps;

when young, the head and tail are somewhat swollen, and in this state one kind has been described as looking like "little animated dumb-bells." When they attain their full size, they prepare to pass into the chrysalis state, and here their methods are equally diverse. A few hang themselves up by threads, like butterflies; others penetrate the ground, and, without any web, change into a naked, brown-colored pupa, which reposes in a sort of cell, made merely by the movement of the caterpillar pressing back the earth. This is the burial of Psyche. From it a host of oratorical and poetical figures are taken. It affords, in one way, even religious consolation. The human body, buried in the mold, gives to eternity and heaven the soaring soul, as the chrysalis, from its earthy cell, discloses the moth which beats the ether with unquiet wing. Again, many kinds of caterpillars spin thick cocoons, as the "American silk-worm" (*Telea polyphemus*), the "cecropia moth" (*Platysamia cecropia*), and the "sassafras emperor" (*Callosamia Promethea*). Many have been the efforts to utilize the silk thus made by our native moths, and interesting experiments are detailed with that spun by the American silk-worm, as published by Mr. Trouvelot. The silk of all these species can be no doubt used, because the Chinese and Japanese silk-worms belong to the same or nearly related genera. But none of them equal the original Indian or European silk-worm, the *Bombyx mori*, cultivated chiefly in the south of Europe, and which yields the silk of commerce. After several unsuccessful attempts, of late years, the rearing of the cocoons has been profitably undertaken in the United States, probably through the establishment of silk-mills and the protective tariff which stimulates the silk industry.

Everywhere in the country one may find the chrysalides of moths. Under stones, under moss, and beneath the loose bark of stumps, spun fast to branches and wrapped in the dead leaves of autumn, at the foot of the trees which fed the caterpillars, they may be found in all sorts of hiding-places. The duration of the apparently torpid chrysalis-life is different with the season and the species. From a few weeks to sometimes two years, the still nascent insects lie imprisoned. But at length the hour for escape arrives. The brown shell of the chrysalis splits, and the moth, struggling out of all its envelopes, crawls to some near foothold, where it may shake out and expand its feathery wings in safety. And then, when night comes, and the breeze, it gives itself to the darkness, braving all dangers, to deposit its eggs in safety and perpetuate its species, its main object accomplished often at the sacrifice of its own brief life.

While the moths are inseparably connected with the butterflies, we shall know them by their antennæ not being knobbed at the tip, their more downy wings and body, their generally softer colors, and their usual sleepy habit in daytime, when they fold their wings and seek dark places for repose.

Except a few small groups, most of which I can not admit as forming distinct families, our North American moths may be divided into ten groups, to each of which the term "family" is applied, just as we have the same term given to certain similar groups of other animals, such as the birds or fishes. These ten families are: 1. The *Sphingidæ*, or "hawk-moths," of which we have 91 species in our territory; 2. The *Ægeriadæ*, or "clear-wings," of which there are catalogued about 120 sorts; 3. The *Zygænidæ*, or "clear-spots," comprising over 60 kinds; 4. The *Bombycidæ*, or "spinners," of which there are more than 400 species; 5. The *Noctuidæ*, or "owlet-moths," with nearly 1,600 different kinds; 6. The *Geometridæ*, or "spanners," with 500 species; 7. The *Pyralidæ*, or "snout-moths"; and 8. The *Tortricidæ*, or "leaf-rollers," with over 400 kinds of each; 9. The *Tineidæ*, or "leaf-miners"; and 10. The *Pterophoridæ*, or "feather-moths," the former a large family of minute and often brilliantly colored species, the latter a smaller one containing curious slender moths, having the wings split into feathery fingers or rays. These last two groups are very incompletely known.

[*To be continued.*]

CONCERNING KEROSENE.

By Professor S. F. PECKHAM.

A MODERN French writer has said: "In the domain of the useful arts each age reveals characteristic tendencies. In the last century, mankind had need to clothe itself cheaply. . . . The nineteenth century has wished for light." To the development of the petroleum industry the gratification of this wish is mainly due; yet, while the products of petroleum are used in nine tenths of all the dwellings of the land, but few of those who occupy them realize that 60,000 barrels of crude oil flow from the earth every day, that more than 30,000,000 barrels are now stored above-ground in huge iron tanks, and that 15,000 barrels are required to supply each day's demand in the United States alone. Of this vast quantity, by far the largest proportion is consumed as illuminating oil, or kerosene, for the production of which a stream of oil is constantly flowing through six-inch pipes from the oil-region of Western Pennsylvania to Baltimore, Philadelphia, and Jersey City. In each of these cities establishments, constructed for the purpose, convert the crude oil into various products, principally illuminating oil, for the home market and an export trade of vast proportions. In these refineries the oil is first allowed to settle in large tanks, in which a small percentage of water and sediment accumulates. From these tanks the oil is pumped into stills, holding

about 1,200 barrels each, beneath which fires may be kindled, and urged by a strong draught until a red-heat is attained.

Petroleum consists of a great many different fluids, which range in volatility from the boiling-point of ether to nearly a red-heat. Such being the case, as soon as the oil is heated at all, the most volatile products begin to come over, at first colorless as water, but very gradually assuming a yellow tinge until the most dense distillate coming over at the last is quite dark brown in color, so that, if all the distillate were allowed to run into a tank together, it would not look very differently from the original petroleum. In the ordinary process of refining petroleum, the distillate is divided into three portions. The first is the lightest, colorless portion, nearly as volatile as ether, and is called crude naphtha, or "benzine." Like the crude petroleum, this crude naphtha may be distilled and divided into gasolene, A, B, and C naphtha, which are used in gas-machines, for mixing paints, and other similar purposes, sometimes also for burning in lamps and stoves.

The middle portion of the distillate, which is neither very light nor very heavy, and having but little color, is the crude illuminating-oil, or kerosene. As it runs from the still it has a very offensive odor, due to the decomposition of certain portions of the petroleum at the high temperature reached in the still. To remove the offensive compounds, the oil is first agitated with about five per cent of strong oil of vitriol. This combines with the offensive oils, forming a black, tarry residue that falls to the bottom of the tank as soon as the oil is brought to rest. This mixture of acid and oil is called "sludge," and is used in large quantities in the manufacture of commercial fertilizers. After the acid is drawn off and the oil washed with water, it is again washed with a strong solution of caustic soda, which removes the excess of sulphuric acid, and also some peculiar acid compounds that exist in the oil. The oil, after another washing with water, is nearly colorless, with the peculiar balsamic odor of kerosene, and possesses the slight opalescence peculiar to these oils. As usually prepared, they belong to the class known as "high-test" kerosenes, and consist almost entirely of oils that exist in the petroleum already formed, being merely separated from the lightest and heaviest portions. Such oils are called the *educts* of the petroleum.

The heaviest portions of the distillate contain paraffine, and are called paraffine-oils. They also are mainly educts of the original oil; they, however, contain a much larger proportion than the kerosene of the products of the decomposition of the oil. A tarry residue remains in the still, called "residuum."

In other establishments the naphtha and illuminating oil are distilled from the petroleum, and the dense oil remaining in the still, called "reduced petroleum," is drawn out and used for lubrication. A large part of this dense oil from which the naphtha and illuminating oil have been removed is "cracked," or destructively distilled, by

slacking the fires, and allowing the distillation to proceed so slowly that the dense portions of the vapors are condensed on the dome of the still, and, falling back upon the surface of the hot oil, are heated above their boiling-points, and decomposed into a lighter oil and a carbonaceous residue. By continuing this process for several hours the oil has passed out of the still, leaving a quantity of residuum, as in the first instance. This cracking process is never complete, as a portion of the oil is cracked too much and another portion too little; but the average gives a burning-oil of the proper density, color, etc., while in other respects it is greatly inferior to the oil that is not cracked. The reader will readily perceive that by mixing these constituent oils of the petroleum suitable for burning-oil, which have been very properly called "normal" burning-oils, with different proportions of the cracked oils, a great variety of products may be obtained; but I propose in this article to speak of only three classes of burning-oils, and to show that these three classes may furnish oils that meet the demands of legal enactments, while at the same time they may be both very dangerous and very bad.

The first class of oils mentioned that are distilled from the petroleum unchanged consists of compounds of hydrogen and carbon combined in such proportions that the percentage of hydrogen is greater than in any other similar substances. In addition, they are very inert to chemical reagents, in this respect resembling paraffine or India-rubber. They may be washed with sulphuric acid or strong solution of caustic soda, and very completely purified; but they are not acted on by either of these powerful reagents, and the product is a pure, colorless oil, with the odor of kerosene, and burning with a dazzling, white flame. The wick is burned but little more rapidly than that of an alcohol-lamp. The flame does not smoke, neither does it emit any unpleasant odor. These oils are safe, healthful, and economical; in fact, they constitute the best and cheapest illuminating agent ever given to man.

When the oils too heavy for illuminating oils are destructively distilled or "cracked," the product is largely contaminated with oils containing less hydrogen in proportion to the carbon, and which are not inert to chemical reagents like those just described. When these oils are treated with sulphuric acid, both the oil and the acid are decomposed. The sulphur and a part of the oxygen of the acid (SO_3) take the place of a part of the hydrogen of the oil, while this hydrogen unites with the remaining oxygen of the acid and forms water. This sulphur and oxygen thus become constituents of the oil, and when the oil is burned they escape into the room as sulphurous oxide identical with the fumes of burned brimstone. But this is not all: the sulphur compounds, and the heavy, imperfectly cracked oils, soon impair the capillary attraction of the wick; and, the flow of the oil being impeded, the wick becomes charred and coated with unburned carbon.

This imperfect combustion produces smoke and imparts to the atmosphere of the room unpleasant odors, and not infrequently leads to an explosion of the lamp and disastrous conflagrations. The steady flow of the oil through an unencumbered wick keeps the wick burner comparatively cool, and prevents the heating of the lamp and of the oil within it; but, when the capillarity of the wick is impaired, the burner, lamp and oil within it become heated to a temperature that finally produces a distillation of the lighter portion of the oil, in many instances causing the flame to become dense and smoky; sometimes streaming above the top of the chimney; and, if not speedily extinguished, resulting in an explosion and the destruction of the lamp.

When the normal and cracked oils are mixed, the mixture partakes of the mingled characteristics of the constituents. The mixture may be nearly as good as the normal oils, or nearly as bad as the cracked oils. At the present time the *common* kerosene sold is either a "cracked" or a "mixed" oil, while the bulk of the *high-test* kerosene is supposed to consist of "normal" oil; and, while any or all of these oils may be of any required test, they are of very various quality in other respects.

The test of an oil, "high" or "low," represents the temperature to which the oil must be heated in order that a suitable quantity—usually one half-pint—may give off a sufficient amount of inflammable vapor to either flash or burn. The temperatures at which the same oil will flash and burn vary greatly with the character of the oil, being from 10° to 50° apart by Fahrenheit's scale. While it has been repeatedly demonstrated, by several of the most eminent scientific experts now living, that the temperature at which an oil will burn is of no importance as an indication of its safety, this test is still in use in many localities. It is, however, the temperature at which the vapors will flash that is usually understood as the "test" of an oil, and it varies from 70° to 90° Fahr. in low-test oils to 120° to 140° in high-test oils. Experiment has repeatedly demonstrated that an oil that will give off vapors that will flash at 100° Fahr. is safe for any legitimate use. As painful and disastrous accidents are liable to follow the explosion of a lamp, and as the increased danger of explosion where low-test oils are used is obvious to any reflecting person, all efforts to restrict the manufacture or sale of unsafe oils by legislation have been hitherto directed toward the exclusion of very low-test oils from the market. In England such legislation has been based upon very elaborate research, and has been in the main successful; but in the United States no less earnest though less carefully considered measures have been embodied in legislation which has resulted in the enactment of a great variety of statutes—giving to some States laws unreasonably exacting, to others wise provisions, while yet others have no legislative restrictions whatever. Of course, such diverse enactments relating to a

single interest and question can not command the respectful consideration that uniform, just, and reasonable legislation would receive from all intelligent persons interested; hence, it may be fairly stated that in this country legislation relating to the testing of petroleum is in in many respects unsatisfactory.

It is not, however, to the generally unsafe character of low-test oils that I wish to call attention, but to those characteristics, not yet generally or fully recognized, that render some oils that come within the legal provisions regarding test unhealthy and unsafe for use.

The petroleum industry, in many of its aspects, is the product of development. This statement is true, not only as respects its vast magnitude, but also as pertaining to many of its details. The process of cracking had been employed in treating the distillates from coal before petroleum became an article of commerce; yet petroleum, for a number of years following its discovery in large quantities, was uniformly distilled into naphtha, normal burning-oil, and paraffine-oil. At that time but few uses were known for naphtha, and it was a drug in the market. At the same time the paraffine-oils were contaminated with more or less of the products of destructive distillation that were unavoidable attendants of even rapid distillation. These oils were consequently very poor lubricators, and, moreover, possessed a very unpleasant odor. They never commanded a good price and were slow of sale, for which reason it was obviously the interest of the manufacturer to put into the burning-oil as large a proportion of the naphtha as possible, for the purpose of holding in solution a maximum quantity of paraffine-oil. This often produced an oil unsafe from excess of naphtha, but it was an oil consisting mainly of normal oil, and almost entirely of the educts of the petroleum. Sulphur had not then been observed as an impurity in burning-oil, although the same process of treatment was then used, but less carefully than now. As the original district of Oil Creek produced, at the end of ten years, a smaller proportion of the entire production of crude oil, the character of the burning-oil on the market in 1875 was different from what it was in 1865. At the former date the "lower country," so called in Butler and Clarion Counties, yielded an oil in some respects different from that of Oil Creek, and unequaled for the manufacture of burning-oil, inasmuch as the percentage of normal oils suitable for burning was found to be considerably greater. In five years the diminished production in the Butler-Clarion field, and the increased production of the Bradford district, together with the mixing of the entire production in huge tanks and pipe-lines without regard to quality, had entirely changed the relation of the amount of normal to that of cracked and mixed oils. The vast production and low price of crude oil had thrown the manufacture of petroleum into the hands of corporations controlling immense capital, and establishments in which the oil is handled in quantities proportionate to the enormous demand. Mean-

time a method of refining petroleum had been generally introduced, by which a large proportion of the total burning-oil produced consisted of mixed or cracked oils. Such a proportion of high-test oils as were demanded by the market was made, but the great bulk of the distillate had been converted into a cracked or mixed oil. The petroleum was distilled but once, the naphtha was removed, and then the remainder of the oil manipulated to produce such crude burning-oils as were desired, leaving in the still only a small percentage of residuum. These crude burning-oils were treated with sulphuric acid and caustic soda in such a manner as to produce the lightest colored oil possible, and they were further manipulated to bring the test within the legal requirements. As it was much less difficult to bring the mixed or cracked oils within the requirements of a burning rather than a flash test, the burning test has always found strong advocates among a certain class of the manufacturers of petroleum. This method of manufacture was well established, and the markets of the world were well accustomed to handling the various products during that period when the bulk of the crude oil came from the Butler-Clarion district. But gradually, as has been stated, the major portion of the crude oil that flowed into the pipe-lines was no longer from the Butler-Clarion wells, but from those of Bradford. By the end of 1881 more than three quarters of the crude oil was Bradford oil, and the relative proportion has steadily increased. This change in the crude material has been accompanied by a corresponding change in the character of the product. Instead of mixed and cracked oils, consisting largely of normal burning-oil, the products of Bradford crude oil consist largely of the products of destructive distillation, and this is due to the fact that the petroleums of the Butler-Clarion and Bradford districts represent two extremes; the first contains the smallest proportion and the latter the largest proportion of paraffine-oils of any crude petroleums found in large quantities. The proportion of cracked oils in the distillate from the Butler-Clarion petroleum was too small to injure the general quality of the oil. In the Bradford distillates, on the contrary, the products of destructive distillation give character to the whole. And not only is this statement true, but the proportion of high-test normal oils to be obtained at present from the pipe-line crude oil has gradually become so reduced that the best brands of oil on the market have deteriorated, until it is very difficult, if not impossible, to purchase an article of burning-oil equal in quality to the best offered for sale a few years since. All this time the requirements of law in regard to test have been met, perhaps it may be said, with increased faithfulness.

From the foregoing pages it must be manifest that any improvement in the increasingly bad quality of kerosene can be looked for only from one of two directions. Either it must come from the development of a new field for crude oil of superior quality, or from the in-

troduction of new methods of manufacture. There are no indications at present that warrant any expectation that any material change is imminent in the character of the crude oil. The change must, therefore, come from the introduction of different methods of manufacture. These methods need be neither novel nor unreasonably expensive. Cracked oils of good quality are nothing new, but I have never seen them made by one distillation and one treatment. Cracked oils should be finished by distillation, not treatment. A second distillation would enable the refiner to first remove the two volatile products of cracking and the heavy, uncracked portion of the paraffine-oil, besides destroying the sulphur compounds. But such a technology would so far increase the cost of the oil that those employing it could not compete in the market with those who did not, except by virtue of the superior quality of their oil.

It is in respect to this difficulty that the public weal could be well served by judicious legislation that in its broadest sense might well be considered sanitary legislation. It is a proper subject for physicians to determine, what the precise effects upon the general health may be resulting from the combustion in lamps and stoves of the vast quantities of inferior oils that are daily consumed throughout the country. That the effect must be bad, determining a tendency to certain forms of disease and aggravating others, can not fail to be apparent to the most unreflecting person, especially when it is considered in how few instances any means are employed to remove from the apartment in which these oils are burned the products of combustion. When under such circumstances a pure oil is burned into pure water and carbonic acid, the atmosphere receives a sufficient burden; but when to these are added vapors of burned sulphur and a variety of irritating vapors with smoke, the eyes, lungs, and nostrils pay a heavy tribute. Added to this is the new source of danger from fire resulting from explosions arising from imperfect combustion—a source of danger not hitherto recognized in legislation, but of not infrequent occurrence.

For the reasons stated, it appears that the health and safety of the public, and the protection of those manufacturers who would make a radical change in the methods of manufacture now employed, alike demand legislation that will exclude from the market not only oils that are unsafe from excess of naphtha, but those which in their general character are unhealthful to use and unsafe from other causes. Such legislation should be based upon an exhaustive scientific examination of the subject, with a view to placing the fewest restrictions upon the manufacture and sale of these oils consistent with the demands of public health and safety. Such an investigation can best be undertaken by the General Government, to be followed by such amendments to the national legislation now in force as the results might justify. Such national legislation, based upon a comprehensive knowledge of the subject, could not fail to be followed by a general revision

of State and municipal legislation throughout the country and the enactment of uniform laws that, while securing the adequate protection of the public, would no longer embarrass by needless and unreasonable requirements the manufacture and sale of articles in universal demand.

THE CHEMISTRY OF COOKERY.

By W. MATTIEU WILLIAMS.

LI.—MALTOSE AS A COOKING AGENT.

A FEW years ago the "farmer's friends" were very sanguine on the subject of using malt as a cattle-food, and at agricultural meetings throughout the country the iniquitous malt-tax was eloquently denounced because it stood in the way of the great fodder-reform. The malt-tax was repealed, and the subject fell out of sight and hearing immediately thereafter. Why was this?

The idea of malt-feeding was theoretically sound. By the malting of barley or other grain its diastase is made to act upon its insoluble starch, and to convert it more or less completely into soluble dextrine, a change which is absolutely necessary as a part of the business of digestion. Therefore, if you feed cattle on malted grain instead of raw grain, you supply them with a food so prepared that a part of the business of digestion is already done for them, and their nutrition is thereby advanced.

From what I am able to learn, the reason why this hopeful theory has not been carried out is simply that it does not "pay." The advantage to the cattle is not sufficient to remunerate the farmer for the extra cost of the malted food.

This may be the case with oxen, but it does not follow that it should be so with human beings. Cattle feed on grass, mangel-wurzels, etc., in their raw state, but we can not; and, as I have already shown, we are not even graminivorous as they are—we can not digest raw wheat, barley, oats, or maize.

We can not do this because we are not supplied with such natural grinding apparatus as they have in their mouths, and we have a much smaller supply of saliva, besides a shorter alimentary canal.

We can easily supply our natural deficiencies in the matter of grinding, and do so in our flour-mills; but at first thought the idea of finding an artificial substitute for saliva does not recommend itself. When, however, it is understood that the chief active principle of the saliva so closely resembles the diastase of grain that it has received the name of animal diastase, and is probably the same compound, the aspect of the problem changes.

Not only is this the case with the secretion from the glands sur-

rounding the mouth, but the pancreas, which is concerned in a later stage of digestion, is a gland so similar to the salivary glands that in ordinary cookery both are dressed and served as "sweetbreads," and its secretion, the pancreatic juice, is a liquid closely resembling saliva and containing a similar diastase, or substance that converts starch into dextrine, and from dextrine to sugar. Lehmann says, "It is now indubitably established that the pancreatic juice possesses this sugar-forming power in a far higher degree than the saliva." Besides this there is another sugar-forming secretion, the "intestinal juice," which assists the graminivorous animals in the digestion of raw grain. This being the case, we should, by exercising our privilege as cooking animals, be able to assist the digestive functions of the saliva and the pancreatic and intestinal secretion, just as we help our teeth in the flour-mill; the means of doing this is offered by the diastase of malt.

In accordance with this reasoning I have made some experiments on a variety of our common vegetable foods, by simply raising them (in contact with water) to the temperature most favorable to the converting action of diastase) 140° to 150° Fahr.), and then adding a little malt-extract or malt-flour. This extract may be purchased ready made or may be prepared by soaking crushed or ground malt in warm water, leaving it for an hour or two, or longer, and then pressing out the liquid.

I find that oatmeal-porridge, when thus treated with malt or malt-extract, is thinned by the conversion of the bulk of its insoluble starch into soluble dextrine; that boiled rice is similarly thinned; that a stiff jelly of arrowroot is at once rendered watery, and its conversion into dextrine is demonstrated by its altered action on a solution of iodine. Instead of instantly striking a blue-black color on admixture, only a slight brownish tinge is displayed, and not even this when the temperature has been carefully maintained.

Sago and tapioca are similarly changed, but not so completely as arrowroot. This is evidently because they contain a little nitrogenous matter and cellulose, which, when stirred, give a milkiness to the otherwise clear and limpid solution of dextrine.

Pease-pudding when thus treated behaves very instructively. Instead of remaining as a fairly uniform paste, it partially separates into paste and clear liquid, the paste being the cellulose and vegetable casein, the liquid a solution of the dextrine or converted starch. Turnips, carrots, potatoes, etc., behave similarly, the general results showing that, so far as the starch is concerned, there is no practical difficulty in obtaining a practically sufficient amount of conversion of the starch into dextrine by means of a very small quantity of maltose.

"Hasty-pudding," made of boiled flour, is similarly altered; generally speaking, the degree of visible alterations is proportionate to the amount of starch, but, the smaller the proportion and the greater that of cellulose, the more slowly the change occurs.

I have made a malt-porridge by using ground malt, from which I sifted out as much husk as possible, instead of oatmeal. I found it rather too sweet; but, on mixing about one part of malt-flour with four or more of oatmeal, an excellent and easily-digestible porridge was obtained, and one which I strongly recommend as a most valuable food for strong people and invalids, children and adults.

Further details of these experiments would be tedious, and are not necessary, as they display no chemical changes that are new to science, and the practical results may be briefly stated without such details.

I recommend—1. The production of malt-flour by grinding and sifting malted wheat, malted barley, or malted oats, or all of these, and the retailing of this *at its fair value* as a staple article of human food. Every shopkeeper who sells flour or meal of any kind should sell this.

2. That this malted flour, or the extract made from it as above described, be mixed with the ordinary flour used in making pastry, biscuits, bread, etc.,* and with all kinds of porridge, pea-soup, and other farinaceous preparations, and that when these are cooked they should be slowly heated at first, in order that the maltose may act upon the starch at its most favorable temperature—50 or 60° below the boiling-point.

3. When practicable, such preparations as porridge, pastry, pea-soup, pease-pudding, etc., should be prepared by first cooking them in the usual manner, then stirring the malt-meal or malt-extract into them, and allowing them to remain for some time. This time may vary from a few hours to several days—the longer the better. I have proved by experiments on boiled rice, oatmeal porridge, pease-pudding, etc., that complete conversion may thus be effected. When the temperature of 140° to 150° is carefully obtained, the work of conversion is done in half an hour or less. At 212° it is arrested. At temperatures below 140° it proceeds with a slowness varying with the depression of temperature. The most rapid result is obtained by first cooking the food as usual, then reducing its temperature to 150° and adding the malt flour or extract, and keeping up the temperature for a short time.

4. Besides the malt-meal or malt-flour, which I presume will be preferably made from barley, I recommend the manufacture of what I may call "pearl-malt," that is, malt treated as barley is treated in the manufacture of pearl-barley. This pearl-malt may be very largely used in soups, puddings, and for other purposes evident to the practical cook.

* I have lately learned that a patent was secured some years ago for "malt-bread," and that it is still obtainable from many bakers, who make under a license from the patentee. The "revised formula" for this, which I have just obtained, says: "Take of wheat-meal, six pounds; wheat-flour, six pounds; malt-flour, six ounces; German yeast, two ounces; salt, two ounces; water sufficient. Make into dough (without first melting the malt), prove well, and bake in tins." Malt-flour is also sold, but at fancy prices, absurdly beyond its just value.

It may be found preferable to the malt-flour or meal for some of the above-named purposes, especially for making a *purée* like Rumford's soup. I strongly recommend such a soup to vegetarians, i. e., the Rumford soup No. 1, already described, but with the admixture of a little pearl-malt with the pearl-barley (or malt-meal failing the pearl-malt).

A small proportion of malt flour, one twentieth for example, has a considerable effect, and if a fancy price is to be paid for it such a proportion may be used; but, if it comes into sufficient demand to be subject to wholesome competition, larger proportions up to one fourth will be desirable.

In my experiments I used the malt-extract in order to render the result visible, but this is not necessary in practice. Either the extract or the flour may be used, as may be convenient. In all cases time should be allowed for the conversion of the starch to take place before raising the temperature to 212°, keeping in view the principles above explained as regards the temperature and time required for conversion.

I have not yet met with any malted maize commercially prepared, but the experiments that I have made on a small scale show that it is a very desirable product. I name it here and now (January 8, 1885) to prevent its becoming patented, as there are so many greedy people who rush to the Great Seal Office with any idea they may pick up, however trivial. Any previous publication of the invention is sufficient to frustrate the monopoly. The same applies to the other uses of malt that I have specified.

I am still unable to speak positively as to the efficiency of vegetable diastase in breaking up or effecting the hydration of cellulose and its conversion into sugar; but the following facts are promising:

I treated sago, tapioca, and rice with the maltose as above, and found that at a temperature of 140° to 150° all the starch disappeared in about half an hour, as proved by the iodine test. Still the liquid was not clear; flocculi of cellulose, etc., were suspended in it.

I kept this on the top of a stove several days, the temperature of the liquid varying from 100° to 180°, while the fire was burning, and falling to that of the atmosphere at night. The quantity of the insoluble suspended matter sensibly diminished, but it was not entirely removed.

This has led me to make further experiments, now in progress, on the ensilage of human food, with the aid of diastase. I am packing various kinds of vegetable food in small silos, adding to them varying proportions of malt-flour or malt-extract, and I hereby declare, for the benefit of would-be patentees, that this invention, whether worthless or otherwise, is mine, and can not be secured by them, as I have witnesses of the date of this writing and copy thereof. I shall certainly not patent this or any of the above inventions myself, and will prevent others from interfering with their free use in the improvement and cheapening of our food-supplies. I am also treating such vegetable

food material with various acids for the same purpose, and make the same claim in reference to this.

When by these or other means we convert vegetable tissue into dextrine and sugar, as it is naturally converted in the ripening of a pear, and as it has been artificially converted in our laboratories, we shall extend our food-supplies in an incalculable degree. Swedes, turnips, mangel-wurzels, etc., will become delicate diet for invalids, horse-beans better than beef; delicate biscuits and fancy pastry, as well as ordinary bread, will be produced from sawdust and wood-shavings, plus a little leguminous flour.

This may be done now. Long ago I converted an old pocket-handkerchief and part of an old shirt into sugar. Other chemists have done the like in their laboratories. It has yet to be done in the kitchen.

I should add that the sugar referred to in all the above is not cane-sugar, but the sugar corresponding to that in the grape and in honey. It is less sweet than cane or beet sugar, and a better food.

I now conclude this series, with the expression of my firm conviction that the application of chemical science to cookery is capable of vastly extending and improving our food-supplies, and thereby of greatly increasing the numbers of prosperous human beings capable of living on the earth. This, however, demands a great deal of further experimental research.

I have done so little of this in proportion to my suggestions for further research that I fear my readers will liken these papers to those others found by Prince Hal in the pockets of Jack Falstaff: "Oh, monstrous! but one half-pennyworth of experimental bread to this intolerable deal of speculative sack!"

SKETCH OF DR. ALFRED E. BREHM.*

ON the 11th of November last there died a man who is entitled by every consideration to a distinguished place in the pages of a scientific journal. For, whatever Alfred Brehm may have lacked in the systematic formalism of technical zoölogists, it can not be denied that he was really great and even unique in the sympathetic comprehension of animals as living beings. Other works similar to the "Thierleben" ("Animal-Life") exist, and have great merit, but in this sympathetic aspect they are far behind this ten-volumed work. It in no way detracts from his merit that he had to call in specialists to assist him in describing the insects and the lower animals; for these departments are a world in themselves, requiring a whole lifetime for their study,

* We are indebted for the materials of this sketch to an affectionate memoir of Dr. Brehm, published by Dr. Karl Müller in "Die Natur" of December 27, 1884.

and his life was too short to compass everything. But he opened a new door to the vertebrate world; and, if the question be asked how it was possible to give so large and expensive a book permanent currency with the German public, the answer must be found in the sympathetic element of the work, which brought a new world so near to us, and so inspired it that the soul-life of animals is no longer an empty sound.

It was ALFRED BREHM'S privilege to grow up among the most favorable circumstances conceivable for a nascent naturalist. He was born on the 2d of February, 1829, at Renthendorf, near Neustadt, on the Orla. He could have had no better guide to his future course than his father, the pastor of the parish, who as "Father Brehm" was known among the older ornithologists of his time as indisputably one of the most distinguished observers of the habits of birds. What the no less eminent ornithologist Z. F. Naumann was for Anhalt and its vicinity, Christian L. Brehm was for Thuringia, a favorite region for all lovers of birds, and full of inspiration for youth having a taste for natural history. This inspiration could not fail to work deeply in so receptive a spirit as the son possessed, and he thus grew up literally in an ornithological atmosphere, in which his especial taste and aptitude later took firm root. Thus were early developed in him the future ornithologist and the self-reliant, independent spirit. In 1847 the famous and wealthy African traveler, Baron J. W. von Müller, proposed that he go with him to Africa as his ornithological assistant. It was known that young Brehm was already not only an accomplished ornithologist, who was acquainted with the voices of all the birds, but that he was also a splendid shot, who had himself contributed many precious additions to his father's great collection of European birds, which was estimated to contain nine thousand specimens. Brehm had just passed his abiturient examinations when Müller's invitation came to him; and, as his father had nothing to say in opposition to it, he immediately made his own conditions and decided to go. The journey was to be undertaken at once, and to last five years. Brehm did not return till 1852, after he had explored Egypt, Nubia, and Eastern Soudan, countries that have always had great attractions for zoölogists, especially for ornithologists. Here is the resort of many birds which migrate from Europe to seek a winter home in summer-land, and also the abode of a multitude of African species which never leave that quarter of the world. Naumann also sent his apostles hither at about the same time, and one of them, the youthful Vierthaler, who has long been resting in Nubian soil, described with much spirit, in "Die Natur" for 1852, the kind of a bird-paradise which he found on the banks of the White and the Blue Nile. It was given to young Brehm alone comprehensively to depict this life in his first publication, "Reise Skizzen aus Nordost Africa" ("Travel-Sketches from Northeastern Africa"), three volumes, Jena, 1853. After he had attended the University of Jena, and had subsequently

studied the treasures of the Zoölogical Court-Museum at Vienna, under the guidance of the recently deceased Leopold Joseph Fitzinger, its custodian, he became as it were dead for any other than a scientific world, and only the innate energy of his character enabled him to maintain a fixed purpose in life. For every effort to establish himself was defeated in consequence of his having so long lived a wandering life in Africa—as is generally the case with extensive travelers, he had no taste for a sedentary career—and it was, therefore, not strange to see him starting off again in 1856. This time the field of his researches was Spain and its bird-life, which a brother of his had already studied to some extent. Then, in order to study an opposite region to this, he went in 1860 to the North and visited Norway and Lapland. The fruit of this journey was "Das Leben der Vögel" ("The Life of Birds"), Glogau, 1861, and a general fame as a traveler and writer. He soon afterward received an invitation from Duke Ernst of Saxe-Coburg-Gotha to go with him on a hunting-journey to Bogosland and Abyssinia, which was begun in 1862. At the request of the duke, he worked up the collected impressions and observations of this hasty expedition in 1863 into "Ergebnisse einer Reise nach Habesch" ("Results of a Journey to Habesch"), Hamburg, 1863. The physiognomic and sympathetic tastes characteristic of Brehm are also prominent in this book. He was at about the same time appointed director of the Thiergarten in Hamburg, a position which furnished him an excellent opportunity to add to his store of zoölogical observations. It must have been of much value to him, for he had already conceived the idea of publishing an "Illustrirtes Thierleben" on a grand scale. Nevertheless, he surprised the world four years afterward by voluntarily giving up this position and turning his back on Hamburg.

Brehm was also too busy at that time with his own enterprises to be able to devote his whole powers to responsible positions. His "Thierleben" occupied him closely, and required him to review the whole store of observations which he had collected, especially in his later years. What he himself thought of the subject is shown by the following passage of the prospectus which he wrote for the second edition, in 1876: "The activity of science has also worked fruitfully on the public desire for knowledge. The nearer view that is given to it of animals in Nature (in zoölogical gardens), the word spoken from the professorial chairs of the schools, and its multiplied repetition in writing and picture, have—each supplying its part—contributed to spread, with the knowledge of animals, interest in them and appreciation of them. Thus, man's approach to the forms of creation nearest related to him, his recognition of the existence and life of animals, has taught him that this circle of living beings includes its own life within itself, and simply with the entrance into it has much light been shed over the problem of his own origin, which a rigid dogma had long kept in darkness." In this passage he evidently referred to

the then still new doctrine of descent of Darwin, but a sure tact preserved him from the mistake of permitting it to have any influence on his great work. The prospectus also gives information on this subject; for he says at the close of it, in the name of the publisher: "The question will come up with every one of what will be the attitude of this work toward the movement of our time which is leaving away behind itself the mark of exact research, and is losing its head in the regions of speculation. On this subject it is proper to remark that the author has not followed this movement in the present work; that he has kept aloof from the strifes of the learned and from brilliant conjectures; and in the well-understood interest of the layman, who will seek instruction through him, he has confined himself to demonstrated facts and established observations. No one, therefore, need fear that his faith or conscience will be damaged, or that he will have reason to be afraid on account of his similarity with monkeys." Brehm was also aware that he must in his treatise abandon the region of the systematic in which all other text-books of zoölogy were cast. "With the abandonment of the sterile domain of the systematic," he says again in his prospectus, "a rich field of observation has opened out before the eye of the naturalist." But he well understood that he could not include everything with this one-sided view, and knew that the naturalist could not be a fast-bound teacher, but must lead the life of a hunter and wanderer, as he himself had done till then. He considers expressly, in the preface to the second series of his "Thierleben," the manner in which readers will have to judge it: "The 'Thierleben' is not afraid of a stringent criticism. Whoever seeks in it what the title and the opening pages will justify him in looking for will not find himself deceived; for, if he will always keep the title in mind, he will not seek there for what he can not find." He was so fortunate as to have the aid, in preparing his first edition, of the gifted animal-painter Robert Kretschmer, of Leipsic. The two men were well acquainted with each other. They had both been attached to the Abyssinian expedition, Kretschmer as its artist; and the water-color illustrations of it, painted on the spot, which he brought home with him, are among the most beautiful of their kind. Brehm was, therefore, quite right in calling his first edition an illustrated "Thierleben"; those fresh, lively pictures, painted with such grasping perception and freedom from restraint, contributed greatly to pave its way to the public; without them, the success of the book, notwithstanding its excellent contents, would have been much smaller. Brehm wrote the first five volumes of his book between 1863 and 1868, while Oskar Schmidt and C. L. Taschenberg prepared the sixth volume, containing invertebrates. A second edition, in ten volumes, was published in 1868, and the following years. The great pains with which the whole work was gradually pushed to completion bore good fruit, and, when we state that the book was translated into most of the living literary languages, it is not

necessary to say anything of the appreciation in which it was held by German-speaking people. A popular edition in three volumes was published 1868 to 1872.

During the publication of this great work, Brehm resided in Berlin, where, as in Hamburg, he occupied himself with introducing the public to the forms of life which were described in so masterly a manner in the "Thierleben." A joint-stock company was formed, with a capital of nine hundred thousand marks, for the establishment of a great aquarium, of which Brehm was given the direction. The position, however, did not suit him, for he found himself too closely hedged up for his comfort. The establishment he founded still remains one of the famous sights of the city, but he withdrew from it, to devote himself again to his literary labors, which he varied with lectures in different cities. Among his literary enterprises is a book in two volumes on "Captive Birds," which was published at Leipsic and Heidelberg in 1872.

Brehm again left his country, to pursue zoölogical researches, in 1876, when at the suggestion of Dr. M. Lindermann an expedition to West Siberia was organized in the Bremen Union for Arctic Exploration, the cost of which was defrayed partly by the Union and partly by private contributions and the Russian merchant Michaelovich Sibiriakoff. The expedition consisted of Dr. O. Finsch, Dr. A. Brehm, and Count Waldburg-Zeil-Trauchburg, who joined it as a volunteer. Its route extended over the Ural across the Ischim Steppe, and along the Irtish to Semipalatinsk, to the Arrat Mountains, through the land of the Kirghiz to the Dzungarian Ala-Tau, thence to Nor-Saissan, then over the Chinese Hoch-Altai and through the Altai crownland to the Obi, and lastly across the Tundra to the country of the Ostiaks and Samoyeds, whence Brehm returned home by way of St. Petersburg, where he stayed a short time to deliver lectures. Reaching home safely, he also delivered lectures there, upon the journey he had just performed. In the same year, 1877, he accepted an invitation from the Crown-Prince Rudolph of Austria, to whom he had dedicated the second edition of his "Thierleben," to go with him on an excursion to the forests of the middle Danube, of which the crown prince afterward published a sketch. Two years later, in 1879, he accompanied the crown prince to Spain. In 1880 he, on his own account, visited North America to deliver lectures. This visit had an unfortunate ending; he was attacked by a violent fever; and after he returned home, having gone to Renthendorf, he was prostrated with a disease of the kidneys which soon proved fatal. This premature ending of his life was the more deplorable, because the restless naturalist was engaged on a new natural history of animals, which was to have a very wide scope. In him passed away one of the noblest of Germans, a man to whom the animal world was a world full of spirit and inspiration.

EDITOR'S TABLE.

LIBERTY IN EDUCATION.

DR. McCOSH has published an argument on freedom in the higher education. He had discussed the subject with President Eliot before the Nineteenth Century Club, and he has since issued a pamphlet, entitled "The New Departure in College Education, being a Reply to President Eliot's Defense of it in New York, February 24, 1885." The traditional collegiate system which has descended to us from old mediæval and monastic times, so little impaired in its essential method, is now brought to the test of modern ideas. Not only is it a question of introducing and organizing modern studies in place of the classical studies, that are losing their hold upon the cultivated mind of the age, but this involves an inquiry into the theories and principles of the older and the newer education as to how far we should go in the direction of a more pliant, adaptive, and liberal system, and how far students are to have liberty of choice among the subjects of collegiate study.

Dr. McCosh argues against freedom in the higher education, taking the ground that has ever been taken against the progress of liberty—that it will be abused and run into license. As political liberty was resisted because it would destroy government, and lead to anarchy; as religious liberty was resisted because it would destroy the Church and put an end to religion; and as the liberty of the press was resisted because it would subvert public order—so the liberty of study is now opposed because it will degrade education and destroy the colleges. To all this, the reply dictated by the world's experience is simply that, while there are undoubted objections to liberty, its advantages outweigh its drawbacks. Dr. McCosh maintains that, if the students are left free to elect their subjects, they will choose those which are easiest, and therefore most worthless for purposes of mental cultivation. But this is contrary to both reason and experience. President Barnard, of Columbia College, in a passage appended to this article, testifies that students left free do *not* choose the easier subjects. But the reason of the case is, that what is hard to one student is easy to another; and this fact, with its implications, is the key to the movement in behalf of greater liberty in the choice of studies. Dr. McCosh makes little concession to those rights of individuality which originate in personal aptitudes and diversities of mental constitution, and which impel students to different lines of effort. He would enforce a common method upon all under a theory of mental discipline, rejected by reason and experience, and fortified only by long tradition. Dr. McCosh protests that he is not behind the age or an obstructive, and is "for freedom quite as much as Dr. Eliot is," and he allows "a certain amount of choice of studies," but this is in strict subjection to the classical ideal and the old college practice.

There is talk in this option controversy about a great number of things, but the issue is over compulsory Greek and Latin. It is a fight of the classicists, and, so long as they can force the dead languages, they care very little what else comes or goes. Classical education knows nothing of this modern spirit of liberty. It has ever been closely associated with priestly domination, with religious intolerance, with despotic collegiate authority, and arbitrary state regulation. In the old and powerful English universities the dead languages are the one thing that has

been forced for centuries. They have been legislated as the tests of scholarship, the credentials of culture, and the badges of gentility. That the classical spirit should be one of arrogance and tyranny, and adverse to liberty, is sufficiently explained by the history of the old universities. There is much talk about the freedom of the German universities; but, so far as classics are concerned, their policy is one of simple, unmitigated despotism. Students, of course, are left free to attend lectures and recitations or not, as they please, and to study much as they like; but what does that amount to when they can not get into the universities with any chance of success except through the gymnasium, where they are subjected to years of unrelenting classical drill; and, if they do not graduate in conformity to high classical standards, are unable to get places under the state in either the church, the army, or the civil service? The educational system of Germany is an iron despotism of a military state. Dr. McCosh understands this; and, true to his classical instinct, would be willing to concede the utmost option to Harvard University if Massachusetts would but adopt the German plan. He says:

I know that in Germany they produce scholars without requiring a rigid attendance, and I rather think that in a few American colleges they are aping this German method, thinking to produce equally diligent students. They forget that the Germans have one powerful safeguard which we have not in America. For all offices in church and state there is an examination by high scholars following the college course. A young man can not get an office as clergyman, as teacher, as postmaster, till he has passed by that terrible examining bureau; and, if he is turned by them, his prospects in life are blasted. Let the State of Massachusetts pass a law like the Prussian, and Harvard may then relax attendance, and the State will do what the colleges have neglected to do.

The following passages, from a paper read before the Regents of the University of New York by President Barnard, of Columbia College, is a sufficient answer to the objections urged by Dr. McCosh:

Every new subject of study which has been admitted in the college course since the century began has been admitted in acknowledged violation of the theory on which the course is assumed to have been originally founded. Chemistry has been admitted, for instance, into the course, on the ground that it is important that every well-educated man should know something about the elementary composition of the matter which surrounds him; anatomy and physiology, because he ought to understand the structure of his own frame and the functions of its several organs; and mineralogy, geology, botany, physics, etc., for similar utilitarian reasons. So great is the multiplicity of subjects at present taught as to destroy altogether, especially in later years, the character claimed for the collegiate course as a system of mental discipline.

It is time, as it appears to me, that we should revise our theory of collegiate education, with a view to make it conform a little more nearly to our actual practice; or that we should modify our practice to make it harmonize more nearly with our theory. The most judicious course, apparently, would be to admit, to some extent, both species of change at the same time; and with this would necessarily follow the introduction into the system of instruction of the element of plasticity, permitting it to be varied in its character to accommodate the exigencies of different minds. The doctrine that all varieties of mind may be profitably subjected to the same educational regimen is a doctrine which it is not safe to admit, unless we confine its application to the most elementary stages. The true theory of education is not that theory which aims professedly to secure for all minds identically the same description of development and to force every mind into absolutely the same mold; but that, on the other hand, which anticipates, as inevitable, differences which no external influences can ever compel effectually to disappear, and which adapts its culture to these ineradicable and irrepressible differences.

The first business of education is, therefore, to find out what the individual is fit for; the next is to make the most of him in that for which he is fit, and, according to this true theory of a subject which plausible speculation has done very much to obscure, a special system or training, adapted to the idiosyncrasies of the individual, is just as distinctly in-

dicated for the latter years of a liberal educational culture as a general one, equally enforced on all, is for the earliest. And it further follows that, if at this later period the student is permitted to follow the bent which his previous training has served to develop, his choice will fall upon those studies which are in harmony with his bent without any reference to the question whether they are, in the common sense of the word, "easy" studies or "difficult." For these terms "easy" and "difficult" as applied to matters which concern the understanding, admit of two quite different modes of definition.

No mental pursuit is easy if it be distasteful, no matter how small the labors its prosecution demands; and no similar pursuit is difficult if pleasing, even though to follow it may exact the severest and the most persistently sustained exercise of the faculties. And, in corroboration of the truth of this proposition, it may here be stated that, in Columbia College, under the system which permits the members of the senior class to select, for the most part, studies which they prefer to pursue, there is no lack of volunteers for a subject commonly reported to be so difficult and forbidding as the calculus, or as obscure as the metaphysics; nor is there, on the other hand, any observable predominance in the number who select a branch so fascinating as physics, or so practical as technology or chemistry.

The distribution has been, in fact, approximately equal among all the studies presented for option. And this result is one which we may reasonably look for when parallel courses of study are offered to the choice of the student during the later years of the academic course, whatever might be true if the offer were made at the beginning. For the effect of the early years of training is to bring out the character of each individual mind, and to determine what are its native idiosyncrasies, and what it is possible to make of it. And though the doctrine that all the faculties of all minds should be developed as far as possible by appropriate educational exercise and discipline is a true doctrine, yet the doctrine that all faculties of all minds are equally capable of development is a fallacy which no enlightened educator will think of maintaining.

That every faculty should receive its fair amount of fostering attention is certainly just and right, but to expect that this fair amount or that any amount of individual culture, however laborious, will secure to every individual an equal power or chance of success in any given direction—as, for instance, in poetry or mathematical research—is as unreasonable as to expect that every sapling in a nursery may, by proper care, be made equally prolific of fruit. After all that has been said about the desirability and the importance of symmetrical mental development, and of the duty of shaping the educational culture with a view to secure such a development, the simple fact is that all minds develop themselves unsymmetrically, just as certainly as that different minerals crystallize into different geometrical figures; and that it is just as hopeless for the educationist to look for that ideal conformity and perfection of mental proportion among his pupils which has been so much insisted on as the end at which education should aim as it would be for the chemist to attempt by his science to compel all his salts to crystallize into spheres.

The great evil of the invariable curriculum of study in our colleges at the present time is that it makes it impossible, at least after the end of the second year of the course, to teach any subject with satisfactory thoroughness. From an examination of the programme of instruction in Columbia College for the junior and senior years—I select my own college rather than another that my remarks may not seem invidious—it appears that if every student were compelled to take every subject, and if to every subject should be given an equal proportion of the available time, no single subject, if pursued continuously, could occupy a longer period than about a month. How is it possible to expect results satisfactory either to instructor or to learner from such a state of things as this? There is no remedy for the evil but that of permitting the student to concentrate his attention upon those subjects which are most in harmony with his native bent, and to leave the others to those to whom they in turn may be more acceptable.

DE LAVELEYE ON SOCIALISM.

No apology is needed for printing the long article of M. de Laveleye in reply to Herbert Spencer, together with the latter's brief rejoinder. The Belgian state socialist is a man of mark, who believes in the extension of the powers of government for the general purposes of philanthropy; and it was natural that he should see the need of breaking the force of Spencer's argument. But, quite regardless of that result, his paper is of interest as revealing the condition of mind of a man admitted to be strong in politics

and economics, but who shows such a want of familiarity with the elements of social science as gives confusion to his exposition. Notwithstanding its merits, looseness and inaccuracy in important parts of his paper must go far to impair our confidence in the integrity of his intellectual work.

What trust, for example, can we have in the information or the thinking of a man who says, "Darwin borrowed his ideas of the struggle for existence and the survival of the fittest from Malthus, from whom he also drew his theories of evolution and transformism"? Now, "the struggle for existence" is certainly not an idea belonging either to Darwin or Malthus, but is far older than both. And so also with the principle of the "survival of the fittest"; it is a formula of Herbert Spencer, adopted by him to represent the same idea that Mr. Darwin expresses by the term "natural selection"; but the conception is found in the writings of the earlier naturalists, and what the modern thinkers have done is simply to work out new and important views of their results.

M. de Laveleye constantly speaks in his article of "Darwin's idea," and constantly misconceives it. What Mr. Darwin did was to show how the ideas or principles or conditions of nature known as the struggle for existence and the survival of the fittest, together with heredity and variation, *give rise to new species* of plants and animals. It was an idea belonging strictly to the sphere of biological science, and aiming to account rationally for the great diversities of kinds among organic beings.

M. de Laveleye not only misapprehends "Darwin's idea," of which he is constantly talking, but speaks of it as something seized upon by Herbert Spencer and applied by him to human society. But, in the first place, Darwin had nothing to apply; and, in the second place, Spencer was in the field long before him. The struggle for existence and the survival of the fittest were ideas which Spencer had developed in their social applications, tracing out their results and assigning their limitations in his book upon human society, of 1851; while "Darwin's idea," belonging in quite another field, was not enunciated till 1859.

But this laxity of thought and misinformation affecting the fundamental conception of his argument go further. Not only does he misapprehend the "Darwinian idea," which is in fact entirely irrelevant to his argument, and not only does he constantly make Spencer the follower of Darwin, where Spencer was the actual predecessor, but he discloses an ignorance of the principles he professes to deal with, in their social bearings, which is somewhat surprising in a man who ventures to take issue with the leading sociologist of the age. He accuses Spencer of borrowing from Darwin, and applying to society an inhuman principle, which reverses all the equities of government and gives license to the worst of crimes. He says, "If it be really advisable that the law of the survival of the fittest should be established among us, the first step to be taken would be the abolition of all laws which punish theft and murder." And does M. de Laveleye really consider that it is optional with anybody whether the principle of the survival of the fittest shall be established in society or not? Are not the principles of the struggle for existence and the survival of the fittest simple demonstrated facts of nature, as old as men's observations of the economy of life upon earth, and no more to be escaped than temperature, the atmosphere, or gravitation? Because the law of gravitation is destructive, and maims and kills people daily, and everywhere, and without remorse, is the question to be raised whether or not it is to be established among us? And will M. de Laveleye maintain that the only way "to establish among us this heartless and cruel law of gravitation" is to give everybody a license to kill? The law

of gravitation *is* established, and, with all its deadly results, it is a law of infinite beneficence. Nothing remains for man but to accept it and heed it: if it causes wounds when he stumbles, it is, nevertheless, the condition by which he walks; he is to avoid its injurious effects and secure its useful effects. Nature, of which man is a part, is a mixed system, in which good comes out of evil, and suffering is made tributary to ever-increasing beneficence. The principles of the struggle for existence and the survival of the fittest are inexorable ordinances of Nature, full of violence and death, but through which the progress and improvement and elevation of life upon earth have been accomplished. They were in operation upon a vast scale countless thousands of years before man appeared. They have been in operation in his development many thousands of years before he began to take a conscious and intentional part in the work of his own elevation; and they must continue in operation as long as the present order of natural things prevails, and the movement is upward and onward toward greater good. The sole question is, whether these great laws are to be wisely recognized and made use of by man in furtherance of those ameliorations to which they have already so immensely contributed. Only gross inappreciation of the subject, or sheer intellectual perversity, could assume that these principles require the abolition of the penal restraints of crime in organized society.

LITERARY NOTICES.

JELLY-FISH, STAR-FISH, AND SEA-URCHINS: Being a Research on Primitive Nervous Systems. By G. J. ROMANES. New York: D. Appleton & Co. Pp. 323. Price, $1.75.

THE main object of this work by Professor Romanes is the description of the investigation of the physiology of the animals lowest in organization, with especial reference to determining the presence of a nervous system in them and its extent and functions. The author at first intended to supplement the accounts of his own work with an exposition of the results which had been obtained by other inquirers, concerning the morphology and development of those animals. He found, however, that he would not be able, within the limits of the contemplated book, to do justice to the labors of others, and has confined himself to giving an account of his own researches. The nervous systems of these animals, as studied by Professor Romanes, are mainly subservient to the office of locomotion, the plan or mechanism of which is completely different in the two classes, and unique in each. The investigations of which this treatise is the result were carried on through six summers spent at the sea-side out of the vacations of twelve years, and were profitable and edifying in more ways than one. On this point, the author makes some remarks which form a fitting introduction to the story of his detailed and technical experiments. "Speaking for myself," he says, "I can testify that my admiration of the extreme beauty of these animals has been greatly enhanced—or, rather, I should say that this extreme beauty has been, so to speak, revealed—by the continuous and close observation which many of my experiments required; both with the unassisted eye and with the microscope numberless points of detail, unnoticed before, became familiar to the mind; the forms as a whole were impressed upon the memory; and, by constantly watching their movements and changes of appearance, I have grown, like an artist studying a face or a landscape, to appreciate a fullness of beauty the *esse* of which is only rendered possible by the *percipi* of such attention as is demanded by scientific research. Moreover, association, if not the sole creator, is at least a most important factor of the beautiful; and, therefore, the sight of one of these animals is now much more to me, in the respects in which we are considering, than it can be to any one in whose memory it is not connected with many days of that purest form of enjoyment which can only be experienced in the pursuit of science. And here I may observe that the worker in marine zoölogy has one great advantage over his other scientific brethren. Apart

from the intrinsic beauty of most of the creatures with which he has to deal, all the accompaniments of his work are æsthetic, and removed from those more or less offensive features which are so often necessarily incidental to the study of anatomy and physiology in the higher animals." This book is Volume XLIX of the "International Scientific Series."

GEOLOGY AND THE DELUGE. By the Duke of Argyll. Glasgow: Wilson & McCormick. Pp. 47.

THIS is the substance of a lecture delivered in Glasgow, in which is considered the question whether any scientific evidence exists that there has occurred a deluge, or a great submergence of the land under the sea over a considerable area of the globe; of a temporary character; accompanied with the destruction of animal life; since the birth or development of man; in other words, corresponding with the flood described in the Bible. The author finds evidence of such a flood, not only in universal tradition, but also in many superficial geological facts; among them, the existence of beds of recent marine gravel on mountain-tops in Wales and other countries; the loess, with its abundant land-shells; the extinct mammalian fauna of Europe, of the sudden destruction of which he adduces many evidences; and the masses of mammoths in New Siberia. The evidences of the contemporaneousness of man with the phenomena are discussed, and the question of his antiquity incidentally. The time of the flood in question is believed by the author to have been about the close of the glacial period.

THE RESCUE OF GREELY. By Commander W. S. SCHLEY, U. S. Navy, and Professor J. R. SOLEY, U. S. Navy. New York: Charles Scribner's Sons. Pp. 277, with Illustrations and Maps. Price, $3.

THIS book gives a plain account of the Greely expedition, of the attempts that failed to relieve it, and of the one that finally succeeded. It has been the aim of the writers to describe the events simply as they occurred, and avoid all criticism of the persons who took part in them. This they have done, in the colorless manner in which all stories ought to be told on which the world is to be called upon to pass an impartial judgment. The relation is begun with a general description of the region in which the search was prosecuted, as "the gateway of the Polar Sea," and an account of the circumpolar stations which were established under the auspices of the International Polar Conference, with which Greely's expedition eventually became connected. Then are given accounts of Greely's Lady Franklin Bay expedition and the unsuccessful relief expeditions of 1882 and 1884, and the detailed account of the expedition under Commander Schley which succeeded in bringing back the survivors of Greely's command. Of the spirit in which the last expedition was prosecuted, the author of the book says that all of the officers and men "knew that the object of the voyage was something above and beyond the ordinary calls of service, and . . . felt an earnestness of purpose which a mere exploring expedition would hardly have called forth. At any rate, whatever may have been their feelings, they certainly evinced a determination to spare no pains, to incur any exposure, to assume any required risk, and to be unflagging in watching for opportunities to gain a mile, a yard, or a foot, on the journey toward Greely and his party."

IN THE LENA DELTA. A Narrative of the Search for Lieutenant-Commander De Long and his Companions, followed by an Account of the Greely Relief Expedition. By GEORGE W. MELVILLE. Edited by MELVILLE PHILIPS. Boston: Houghton, Mifflin & Co. Pp. 497, with Maps and Illustrations. Price, $2.50.

OF the world's heroes, the men of the Jeannette Expedition were certainly among the noblest, the sturdiest, and the most enduring. Whether we regard the single incident of the attitude in which Lieutenant De Long's body was found, with the arm frozen stiff in the position in which it was raised and bent to cast his journal to a safer place; or whether we consider the trials and sufferings and pluck of Melville's party, of eleven men, during their trying and lonely journey—we can almost, and when we take note, as well as of these incidents, of the history of the expedition as a whole, we can

quite say with Mr. Philips, that "in all the world's history the story has no parallel." This story has already been told by different persons from different points of view; but by none who had a better right to tell it and from whom the world had a better right to ask for it than Engineer Melville, who after De Long's death was the titular commander of the expedition. The earlier part of the expedition, up to the crushing of the Jeannette by the ice, being already familiar, is but lightly dwelt upon. The real interest begins when the men took to the ice, and increases till the end of the search for De Long's party. The book abounds with incidents that help to realize what Arctic life really is. The constant imminence of its dangers was shown when the floe on which the party were encamped split through the center of De Long's tent; "and had it not been for the weight of the sleepers on either end of the rubber blanket those in the middle must inevitably have dropped into the sea." A strong picture of the straits to which men may be reduced for food appears in the observation that walrus-hide may have the solitary advantage over hemp for ropes, in that "upon a pinch it can be eaten. Indeed, fresh walrus-hide, roasted with the hair on, is toothsome at any time, and many members of our company feasted on it after consuming their rations of pemmican." We have views of what traveling on the ice is when we are told that the men did not mind having their toes protruding through their moccasins so long as the soles of their feet were clear of the ice, but they could not keep them clear; and in the incident of their finding—having, in order to keep all their things together, to go thirteen times over each mile—that, after marching from twenty-five to thirty miles a day for two weeks, they had been drifted back twenty-four miles. Finally, at the beginning of winter, on the 6th of August, they were able and glad to take to the sea, in three boats. They kept together till some time after the 10th of September, when they were separated in a furious storm, and one of the boats was never afterward heard from. It was agreed they should all endeavor to land at Cape Barkin, and meet there. How they landed, and what befell either of the two parties that survived the sea-voyage, are graphically told by Engineer Melville, from his own experiences and from the narratives of Nindeman and Noros and the notes left by Captain De Long.

The account of the Greely Relief Expedition is brief, but testifies to the value of Greely's work—that there is no one living competent to criticise his conduct of the expedition on which he was sent, "beyond affirming that he performed the greatest amount of scientific work possible at least expense, and made good his retreat from depot to depot, until he arrived at the point of safety, where our Government had promised to deposit supplies and have a vessel awaiting to carry him and his band away from the 'Land of Desolation.'" Not daunted by what he has seen and experienced of Arctic traveling, Mr. Melville has started again for the north pole, expecting to reach it, and to confirm a theory he has formed of the proper way of getting there. Believing that no vessel can penetrate the ice-barrier much beyond where explorers have gone, he figures to himself a firm or nearly firm ice-cap interspersed with frequent islands, covering the sea from the eighty-fifth parallel to the pole, and that a properly equipped expedition can cross this and return upon it, the whole distance both ways being only a hundred miles greater than his party traversed from the Jeannette to the Lena Delta; and he believes that the results to accrue from reaching the pole will more than pay for all that has been spent in other efforts.

MIND-READING AND BEYOND. By WILLIAM A. HOVEY. Boston: Lee & Shepard. Pp. 201. Price, $1.25.

AN association of gentlemen engaged in scientific investigation was formed in the spring of 1882, under the designation of the Society for Psychical Research, the object of which was stated in its prospectus to be to examine the nature and extent of any influence which may be exerted by one mind upon another, apart from any recognized mode of perception; the study of hypnotism, mesmeric trance, clairvoyance, and allied phenomena; a careful investigation of data regarding apparitions; and an inquiry into the phenomena commonly called spiritual. Among the members of this society were Lord Rayleigh, the Bishop of Carlisle,

Professor Sidgwick, Professor Balfour Stewart, William Crookes, and Alfred R. Wallace. They made a considerable number of experiments, in which phenomena were developed that are not yet fully accounted for. From the reports on these experiments made by the several committees to whom the supervision of them was intrusted, Mr. Hovey has prepared the present interesting and suggestive volume.

THE PATRIARCHAL THEORY, based on the Papers of the late JOHN FERGUSON McLENNAN. Edited and completed by DONALD McLENNAN. London: Macmillan & Co. Pp. 355. Price, $4.

MR. McLENNAN, in his book on "Primitive Marriage," and in an essay which he published about fifteen years ago, on "The Worship of Animals and Plants," propounded some original and striking views, and opened up new lines of inquiry into the origins and conditions of primitive society. He was making the investigations of which these publications were the first fruits, his life-work, when his career was cut short, before he was able to perfect anything further, by sickness and death; but not till he had seen his views received respectfully, confirmed in his own mind by new facts and circumstances, and made a part of the light under which the continued study of anthropology would be conducted. It was his purpose, if health and strength had been given him, to undertake a general work on the structure of the earliest human societies. "In particular," says his brother, "he felt that he was able to give a much more consistent and intelligible view of the condition of rude or undeveloped communities than anything that had previously been offered to the public." His research being of a very extensive and far-reaching kind, and involving the use of "a very large apparatus of evidence," he proposed "to prepare the way for his larger work by first issuing a critical essay, by which he hoped to clear out of the way a body of opinion, the prevalence of which seemed to oppose an obstacle to the proper appreciation of his constructive argument." This "body of opinion" was represented by the theory that the family living under the headship of the father was the ultimate social unit, which while it is very old, had recently taken its most important and influential shape in the works of Sir Henry Maine. This "critical essay" he had on hand, assisted by his brother, who now completes it, and had carried out to seven of the nineteen chapters of the present volume, with notes embodying his views as to other parts of the work, when he died. The work is necessarily, by the circumstances of the case, somewhat polemical in form, but not wholly so, for the latter part of it is largely devoted to the buildng up of a theory of the origin of agnation, in the course of which it became necessary to go into the whole question of the Levirate and of the family custom of the Hindoos. "It has appeared at all points," says the editor, "not only that the phenomena dealt with are not intelligible on the patriarchal theory, but that they carry us back to a stage of society prior to the form of the family which has a father at its head, to the stage of polyandry, and to the form of the family founded upon kinship through women only. The argument has been throughout constructive as well as critical, and no slight part of the work is purely constructive."

UNITED STATES COMMISSION OF FISH AND FISHERIES. Report of the Commissioner for 1882. Washington: Government Printing-Office. Pp. 1,101, with Plates.

THE commission having completed the tenth year of its work, the report takes general notice of what it has accomplished. It was formed primarily to investigate the alleged decrease of food-fishes in the United States, but had added to its duties in its second year that of promoting the propagation of fish. It has accomplished much for science by prosecuting, or aiding others to prosecute, researches into the general natural history of marine animals and plants. It has made very large collections of aquatic animals in aid of monographic research, and has given a full series to the National Museum, and sets to several hundred institutions of learning, etc. During 1882 it secured a permanent sea-coast station at Wood's Holl; fitted up the Armory Building as its central Washington station; acquired stations in Maryland and Virginia; furthered the artificial production of oysters, and the production and distribution of the carp; and made inquiries into the extensive

destruction of the tile-fish in the North Atlantic. For the future it hopes to extend its general inquiries; to promote improvement in methods and apparatus of fishing, and in fishing-vessels; to determine the extent and general character of the old fishing localities and discover new ones; to improve methods of curing and packing fish for the market; and to continue the work of increasing the supply of valuable fishes in the waters of the United States.

REPORT OF THE OPERATIONS OF THE UNITED STATES LIFE-SAVING SERVICE for the Year ending June 30, 1883. Washington: Government Printing-Office. Pp. 519.

ONE hundred and ninety-four stations were maintained at the close of the year covered by the report—one hundred and forty-nine on the Atlantic, thirty-seven on the lakes, seven on the Pacific, and one at the Falls of the Ohio. The number of disasters to documented vessels and small boats was 416, in which $7,242,729 of property and 4,040 persons were involved, while $5,671,700 of the property and 4,021 persons were saved, and 651 shipwrecked persons were succored at the stations. Twenty-two other persons were rescued who had fallen from wharves, piers, etc. Ten disasters, involving the loss of lives, took place within the scope of the service. All of the nineteen persons lost were entirely beyond human aid.

RESEARCHES ON SOLAR HEAT AND ITS ABSORPTION BY THE EARTH'S ATMOSPHERE. By S. P. LANGLEY. Washington: Government Printing-Office. Pp. 242, with Plates.

PROFESSOR LANGLEY'S observations are already quite well known to the scientific world, and their value is universally acknowledged. They were made on the slopes of Mount Whitney, at a height of twelve thousand feet above the sea, and about three thousand feet below the summit of the mountain, with special instruments of the observer's own devising. Notices of some of the results have been given in the "Monthly." The author expresses the opinion that Mount Whitney is an excellent station for such observations, fully equal to any that is possessed by any other nation; and, upon his recommendation, it has been declared a Government reservation, available for purposes of scientific research. Professor Langley records some very interesting facts respecting a dust-cloud which appears to hang in the Sierras at a certain height above the sea, the effects of which he was able to observe from his camp, and which appears to be permanent. Professor Clarence King ascribes its origin to the loess of China. The author also speaks of large logs, which were found to be quite numerous on the mountain-side at a considerable height above the timber-line, as indicating that the region formerly enjoyed a warmer climate than it now has. The relation of the observations which formed the object of the expedition is very important and interesting to men of science, but too technical for the edification of general readers.

THE STARS AND CONSTELLATIONS. By ROYAL HILL. New York: Funk & Wagnalls. Pp. 32.

THIS work is intended to enable students and others, who are interested in the appearance of the heavens, to identify the principal objects of interest without reference to star-maps, which as a general thing are very perplexing to unprofessional readers. The plan adopted by the author is new, and constitutes the main feature of the work. It consists in the employment of two accurately drawn time-charts, giving the exact time of rising and southing for every day in the year, of twenty-five of the brightest stars, which are more distinctly identified in the text. From the positions of these "landmarks of the sky," any other object at all likely to attract the attention of naked-eye observers is so described that it is very difficult for any person of ordinary intelligence to miss the information desired. As each object is identified, the student can learn whatever is of interest concerning it by consulting the separate account that is given of every conspicuous star and constellation visible in this country. The subject is suitably introduced by some interesting information concerning the constellations, the names and numbers of the stars, and the methods adopted by astronomers to designate them. It is illustrated by several very clear maps of the zodiacal constellations, upon which the place of the

sun for every day in the year is accurately marked. These maps, which show every star in these constellations to the fifth magnitude, we understand are the first ever published based on the admirable photometric observations of Professor Pickering, the Director of Harvard Observatory. We regard the idea on which the plan is based as a sound one, and the execution of the work as conformed to it. The arrangement is simple, and the directions, in the table, in the charts, and in the text, are clear and accurate.

THE "QUINCY METHODS" ILLUSTRATED. Pen-Photographs from the Quincy Schools. By LELIA E. PARTRIDGE. New York: E. L. Kellogg & Co. Pp. 660. Price, $1.50.

THE educational world was startled a few years ago by the report of the great things that were going on in the schools of Quincy, Massachusetts. A new superintendent had been placed over them—Colonel Francis W. Parker—who had dared to break through the shell of formalism and routine within which they were being fossilized, and to infuse into them life, spontaneity, and real progress. The fame of the schools and of the new system—which was not new, however, to many, but too few, teachers of rare genius for their work—spread widely, and Quincy became a place of frequent resort for persons having at heart the interests of real instruction. Among those who went there was Miss Partridge, who recorded what she saw, and now publishes her record. She takes the reader into the school-room and its different classes, day after day, and exhibits, in her printed account, a transcript, exact as it may be, of what occurred there—illustrating how the teacher started, now this subject, now that, and patiently, and with tact, drew out whatever suggested itself to each of the pupils upon it. As the lessons are advanced, they shape themselves into a kind of system, the operation of which is to awaken the minds of the pupils to self-action and independent thinking. The manner in which these accounts are rendered justifies the secondary title of "Pen-Photographs" which the book bears. The author is careful to remind her fellow-teachers that the example-lessons she gives are not to be copied from but are to serve as types, after which teachers must form their own methods according to the bent of their minds and the kind of children they have in charge. The essential features of the Quincy method are flexibility and spontaneity. What is called by that name might, in the hands of a humdrum teacher, become as dead and worthless as any of the stereotyped forms it is intended to supplant. It is its spirit that must be caught, not any of its particular models followed; and the success of its execution will depend most largely upon the power of the teacher to strike out a way of his own.

MORTALITY EXPERIENCE OF THE CONNECTICUT MUTUAL LIFE INSURANCE COMPANY, of Hartford, Connecticut, from 1846 to 1878. Hartford, Conn. Pp. 91.

A SERIES of thirty-seven tables, showing the mortality results of as many kinds of policies or classes of insured, accompanied by a text explaining the table, and calling attention to the more important of the results.

THE VERTEBRATA OF THE TERTIARY FORMATIONS OF THE WEST. By EDWARD D. COPE. Washington: Government Printing-Office. Pp. 1,009, with 135 Plates.

THIS bulky quarto is "Book I" of the fourth volume of the final reports of the Hayden Geological Survey. Its import in paleontological science is of much significance, for it contains a great number of species and genera of vertebrate animals from the fertile tertiary beds of the West, which had not been previously discovered. Some of these fill gaps in the chain of species, and make the connection and the course of development more plain than they were before. The whole collection represents a part only of the results of the researches which the author prosecuted either personally or with the aid of his trained assistants during the exploring seasons of 1872, 1873, 1877, 1878, 1879, 1880 and 1881, and to a lesser extent in some of the intervening years not recorded in this list. The regions in which the explorations were conducted cover portions of the States and Territories included between British America on the north, the western boundaries of Minnesota and Missouri on the east, the northern borders of the Indian Territory and Arizona and the middle of New Mexico on the south,

and the Sierra Nevada on the west. The present volume does not include all the results of Professor Cope's researches, for another is to follow. Professor Hayden well says of the whole, in his letter transmitting the report, that "the amount of new matter toward the origin and history of the mammalian groups brought together by the author in these two volumes is most extraordinary, and will probably never be surpassed." In this single volume are given the vertebrata of the Eocene and of the Lower Miocene, less the Ungulata, with descriptions of 349 species, which are referred to 125 genera. The author sums up fifteen important results that have accrued through the researches here set forth in the discovery of new genera and families, among which are the discovery of the phylogenetic series of the *Canidæ*, or dogs, and the same of the ancestors of the *Felidæ*, or cats. As the book was stereotyped in 1883, all conclusions of later date than that are necessarily excluded from it; but the author's final conclusions from the material described are mostly to be found in a series of illustrated articles he has been publishing in the "American Naturalist" in the years 1883–'85.

THE TEN LAWS OF HEALTH; OR, HOW DISEASES ARE PRODUCED AND PREVENTED. By J. R. BLACK, M. D. Published by the Author. Baltimore. Price (by subscription), $2.50.

A PART of this book was published several years ago. The edition having been exhausted for many years, the matter has been revised to bring it up even with the progress of the age, and an entirely new part has been added, comprising nearly a fourth of the present volume, on thorough disinfection within the sick-room and the sick-bed as the most effective means for preventing the spread of contagious diseases and epidemics. The author is a strong believer in the doctrine that disease is unnecessary and preventable; in his view man is the most sickly of beings, because those—which means most men—"who neither know nor strive to be governed by law in the uses they make of themselves, become victims to hundreds of evils in the various forms of disease." The ten laws of health are taken up in their order and explained; the violations of them are shown, with their attendant results; and the mode of observing them is taught. The first law is, that a pure air must be breathed. To obtain this within the house, supposing that the surroundings are pure, "the great and imperative requirement is air-movement, a decided though gentle current through an occupied room day and night." Second; the food and drink must be adequate and wholesome. The evil to be guarded against in the United States is excess, for inadequateness or a deficiency of food on this continent, although the common sentiment is quite the reverse, is not often a direct cause of disease. As to the quality of our food, as we prepare it, "of the many books published on the subject of cooking, there are few, if any, that have not receipts by the score which can not be excelled for producing indigestion." The effects of tea and coffee and alcoholic stimulants are carefully considered. The third law enforces the necessity and judicious practice of out-door exercise; and the fourth law prescribes adequate and unconstraining covering for the body. The fifth law concerns the exercise of the sexual function. Under the head of the sixth law are considered the effects of changes of climate, and the measures to be taken for safe acclimatization when that step is taken. Regarding changes of climate for the sake of health, the author concludes, from a survey of the available facts on the subject, "that an imprudent change of climate more frequently destroys the health of the healthy than it cures the sickness of the sickly." The seventh law relates to the choice of occupation. Its admonition is to select such pursuits as do not cramp and overstrain any part of the body, or subject it to irritating and poisonous substances; and, of course, to avoid those of an opposite character. Next, we are to keep personally clean, bathing systematically and changing regularly all clothing next to the skin. "Those who for month after month, and even for year after year, do not cleanse and invigorate the skin by frequent baths, followed by brisk friction of the skin, lose the good offices of a very active organ of regeneration, and cause their blood to be in a state very favorable for the production of disease from slight causes." Ninthly, we must preserve the mind in a tran-

quil state, and secure adequate rest and sleep. "For health, as well as happiness, moderation and diversity of pursuits are essential requisites." Tenth and last law: "No intermarriage of blood relations." The principle is kept in view and enforced by frequent repetition that violations of any of these laws work injury from the beginning, the evil increasing as the violations become habitual, and that for years, perhaps, before the sinner perceives that anything of the kind is taking place; even while he may be boastful of his strength and his superiority to the bad effects of his wrong-doing; and that, when the injury is at last revealed, it is generally past remedy.

The injunctions in the second part of the book, for preventing the spread of infectious diseases by stamping them out within the sick-room, are based on the germ theory of disease. The principles on which they are justified, concisely stated, are, that "persons sick of infectious diseases are the breeding hot-beds from which the germs issue; that these germs make of air, drinks, and foods, mediums by which they are carried into the bodies of others; and, that when they once pervade the air, mix with foods and drinks, they can neither be detected nor destroyed; and, as a corollary, that the only time effectually to destroy them is at the bedside as they pass from the bodies of the sick." To wait, as is too often done, till they have escaped, expecting then by sterner measures to stop the spread of disease, "is like waiting until a fire becomes an alarming conflagration before making systematic efforts to subdue it"—and "even far worse." The directions for enforcing this summary disinfection are plain and practical.

RESULTADOS DEL OBSERVATORIO NACIONAL ARGENTINO EN CORDOBA. (Results of the Argentine National Observatory in Cordoba.) By BENJAMIN A. GOULD, Director. Vols. II, III, IV, VII, and VIII. Spanish and English. Buenos Ayres and Cordoba. Pp. (total) 2,243.

WE have already (March, 1882) given a sketch of Professor Gould's life and astronomical work, both at home and in Cordoba, and a notice of the first publication of the results of his observations in the southern hemisphere, in the "Uranometria of the Southern Heavens." The present volumes embrace a part of the record of his work at Cordoba as it has been pursued, in considerable but not complete detail. At the beginning, the author entertained the hope of being able to publish all the observations in essentially the same form as they had been made, affixing the instrumental corrections separately. The observations of the years 1872-'73 were prepared for the press in this form, but the impossibility of carrying out the plan became manifest as the number of results increased; and at last anxiety arose lest it might not be possible to secure a prompt publication of the results in any shape whatsoever. The observations for the catalogue have therefore been given in the compact form adapted to the requirements of the case; and those of the zones with only so much detail as seemed needful when a large proportion of the stars had been observed but once. The original observations and all the calculations have been preserved for reference. The zones which have been surveyed in these observations cover a breadth of 52° 20′ in declination, extending from 23° to 80° south. Previous determinations of position by zone-observations have been essentially differential in their character, in one co-ordinate, at least, when not in both; in the present undertaking, Dr. Gould has endeavored to obtain so-called absolute determinations for all the stars observed. During the eight and a half years of work up to the close of 1880, more than 250,000 stellar observations were made with the meridian-circle; and the number of different stars observed is estimated at 35,000—all belonging to the southern hemisphere. Among the special observations was a careful determination, of positions and proper motion, of fifty-four circumpolar stars for determination of the azimuthal errors of the instrument. Vol. II of the present series contains the observations made in 1872; Vols. III and IV, those made in 1873; and Vols. VII and VIII, the zone-observations made in 1875. In making these observations, between declinations 23° and 47°, the normal width of the zone was two degrees, with 10′ additional at each margin and extremity for overlap; from 47° to 75°, their width increased with the declination; until, finally, the last five degrees, 75° to

80°, were comprised in a single belt. The zones were also subdivided, where that seemed best.

THE DISTRIBUTION OF PRODUCTS, OR THE MECHANISM AND METAPHYSICS OF EXCHANGE. By EDWARD ATKINSON. New York: G. P. Putnam's Sons. Pp. 303. Price, $1.25.

MR. ATKINSON, a man of business, has spoken so often, so intelligently, and so much to the purpose on financial questions as to give him a right to be heard and weight to his views. The present volume includes three essays—on "What makes the Rate of Wages?" "What is a Bank?" and "The Railway, the Farmer, and the Public." The subject of the first essay is attended with a complication of conditions and relations, and differences of opinion upon it are inevitable. Mr. Atkinson takes an optimistic view of the prospects of a satisfactory settlement of the relations of capital and labor on the conditions set forth in his fundamental proposition. He shows that a high rate of wages does not necessarily signify high cost of production, and *vice versa*, and enforces a distinction, too often overlooked, between rate of wages and sum of wages in the manufacture of a given product. The second essay presents an exposition of the principles on which safe banking is conducted. In the third essay the author shows that the railways have performed a great service in our national economy, and that a large reduction in the costs of transportation has been brought about by the consolidation of the principal lines; and maintains that nearly all the features of our present railway system are working, as a whole, for good.

PARADISE FOUND: A Study of the Prehistoric World. By WILLIAM F. WARREN, LL. D. Boston: Houghton, Mifflin & Co. Pp. 505. Price, $2.

THE Count de Saporta, Mr. G. Hilton Scribner, and others, have made our readers familiar with the hypothesis that the cradle of the human race and of all life must be sought at the north pole. The accession of so many men known to be careful observers, imbued with the scientific spirit, and habituated not to express an opinion unless they have reasons at hand with which to fortify it, as have uttered views consistent with this hypothesis, has lifted it up out of the category of speculations to a genuine theory, claiming deliberate investigation. Dr. Warren, who is President of Boston University, has arrived at conclusions nearly coincident with those of Count de Saporta and those who agree with him, through his own independent studies, though not, of course, without having them reenforced by theirs. In the present work, he offers the considerations by which the theory of polar origin is to be supported, carefully worked out, and in their order. Beginning with a survey of the present state of the question of the location of Eden and of the existing theories upon it, he presents in Part Second his own hypothesis, with a definition of the conditions on which it may be admissible; in Part Third, the scientific bearing on it of geogony, geography, geology, prehistoric climatology, paleontological botany, zoölogy, and archæology and general ethnology; in Part Fourth, confirmations of the hypothesis by ethnic tradition—from ancient cosmology and mythical geography, and from Japanese, Chinese, East Aryan, Iranian, Akkadian, Assyrian and Babylonian, ancient Egyptian and Ancient Greek thought; in Part Fifth, further verifications of the hypothesis, based upon a study of the peculiarities of a polar paradise; and in Part Sixth, the significance of the results he has drawn from these considerations.

PUBLICATIONS RECEIVED.

Preliminary Analysis of the Bark of Fouqueria Splendens. By Helen C. DeS. Abbott. Pp. 8.

The Lineal Measures of the Semi-Civilized Nations of Mexico and Central America. By Daniel G. Brinton, M. D. Pp 14.

Proceedings of the Colorado Scientific Society, 1883 and 1884 Denver, Col. Pp. 147, with Plates.

Notes on the Literature of Explosives. By Professor Charles E. Munroe, Annapolis, Md. Pp. 32.

Spiritism: the Origin of all Religions. By J. P. Dameron, San Francisco, Cal. Pp 108.

Elephant Pipes, Davenport, Iowa. By Charles E. Putnam. Pp. 40.

The Filth-Power. By J. B. Olcott. Pp. 41.

Starling Medical College, Columbus, Ohio. Pp. 16.

Contagiousness of Tuberculosis. By W. H. Webb, M. D., Philadelphia. Pp. 28.

Scriptural Temperance. By W. H. Ten Eyck, D. D. New York: R. Brinkerhoff. Pp. 44.

Light of Comparison Stars for Vesta. Pp. 8. Astronomical Observatory, Harvard College. Report of Director. Pp. 12. Observations of Variable Stars in 1884. Pp. 16. All by Edward C. Pickering.

The Lemuroidea and the Insectivora of the

Eocene of North America. Pp. 16. The Position of Pterichthys. Pp. 6. Evolution of the Vertebrata. Pp. 34. Marsh on American Jurassic Dinosaurs. Pp. 2. The Amblypoda. Pp. 38. All by Professor E. D. Cope.

Standards of Stellar Magnitudes. Report of Committee A. A. A. S. Pp. 2.

Proceedings of the State Board of Health of Kentucky, March, 1885. Pp. 32.

Gold and Silver Conversion Tables. Pp. 8. Elevations in the Dominion of Canada. Pp. 48. Fossil Faunas of the Upper Devonian. Pp. 36. On Mesozoic Fossils Pp. 34. Washington: Government Printing-Office.

Sanitary Council of the Mississippi Valley at New Orleans. Pp. 21.

On Color. By Colonel James W. Abert. Pp. 24.

Ancient Aztec or Mexican Method of computing Time. By Colonel James W. Abert. Pp. 30.

State Sanitary Survey. Illinois State Board of Health.

Disinfection and Disinfectants. Preliminary Report, American Public Health Association. Pp. 8.

Batteries. Pp. 24, with Plates. Machinery and Mechanical Appliances. Pp. 12. Reports, International Electrical Exhibition.

The Instruments and Work of Astronomy. By Asaph Hall. Pp. 19.

Dictionary of Altitudes in the United States (U. S. Geological Survey). Washington: Government Printing-Office. Pp. 325.

Herbert Spencer's Philosophy as culminated in his Ethics. By James McCosh. New York: Charles Scribner's Sons. Pp. 71. Price, 50 cents.

The Diamond Lens, with other Stories. By Fitz-James O'Brien. New York: Charles Scribner's Sons. Pp. 337. Price, 50 cents.

"American Annals of the Deaf and Dumb." E. A. Fay, Editor. Vol. XXX, No. 1. Quarterly. Washington, D. C. Pp. 92. Price, $2 a year.

"Bulletin of the Philosophical Society of Washington, D. C." Vol. VII. Pp. 135.

Osteology of Ceryle Alcyon. By R. W. Shufeldt. Pp. 16, with Plates

Forests of the Adirondacks. Report of Brooklyn Constitutional Club. Pp. 11.

The Limits of Stability of Nebulous Planets. By Professor Daniel Kirkwood. Pp. 10.

The Morals of Christ By Austin Bierbower. Chicago: Colegrove Book Company. Pp. 200. Price, 50 cents and $1.

The Six Nations. By Judge Daniel Sherman. Jamestown, N. Y.: Chautauqua Society of History and Natural Science. Pp. 23.

Ohio Agricultural Experiment Station, Columbus. Report for 1884. William R. Lazenby, Director. Pp. 210.

School Bulletin Year-Book of the State of New York for 1885. By C. W. Bardeen. Syracuse, N. Y.: C. W. Bardeen. Pp. 160.

The Eroding Power of Ice. Pp. 12. The Deposition of Ores Pp 17. By J. S. Newberry. New York: John Wiley & Sons.

Proceedings of the Natural History Society of Wisconsin, March, 1885. Pp. 40.

Afghanistan and the Anglo-Russian Dispute. By Theodore F. Rodenbough. New York: G. P. Putnam's Sons. Pp. 139, with Map. Price, 50 cents.

Many Drugs, Few Remedies. By George T. Welch, M. D. Pp. 12.

On Oxygen as a Remedial Agent. By Samuel S. Wallian, M. D., New York. Pp. 52.

Tableau de Diverses Vitesses (Table of Different Speeds). By James Jackson. 446 Broome Street, New York. Pp. 8.

Geographical Society of Paris. Comptes Rendus, January 23, 1885. Pp. 40.

Recent American Socialism. By Richard T. Ely, Ph. D. Baltimore: N. Murray. Pp. 74. Price, 75 cents.

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How to drain a House. By George E. Waring, Jr. New York: Henry Holt & Co. Pp. 222. Price, $1.25.

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The Microtomist's Vade-Mecum. By Arthur Bolles Lee. Philadelphia: P. Blakiston, Son & Co. Pp. 424. Price, $3.

Hegel's Æsthetics. By J. S. Kedney. Chicago: S. C. Griggs & Co. Pp. 302. Price, $1.25.

The Protestant Faith. By D. H Olmstead. New York: G. P. Putnam's Sons. Pp. 77. Price, 50 cents.

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Lessons in Hygiene. By John C. Cutter. Philadelphia: J. B. Lippincott Company. Pp. 160. Price, 50 cents.

Organic Chemistry. By Ira Remsen. Boston: Ginn, Heath & Co. Pp. 364. Price, $1.30.

The Nature of Mind and Human Automatism. By Morton Prince, M. D. Philadelphia: J. B. Lippincott Company. Pp. 173. Price, $1.50.

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The Microscope in Botany. From the German of Dr. J. W. Behrens. By Rev. A. B. Hervey and R. H. Ward. Boston: S. E. Cassino & Co. Pp. 466. Price, $5.

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The Russians at the Gates of Herat. By Charles Marvin. New York: Charles Scribner's Sons. Pp. 185. Price, 50 cents.

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The French Revolution. By H. A. Taine. Vol. III. New York: Henry Holt & Co. Pp. 509. Price, $2.50.

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POPULAR MISCELLANY.

Schools of Fifty Years ago and of To-Day.—The Rev. Edward Everett Hale, in a recent article on "Half-Time Schools," asserted, among other things, that, on the whole, schools and school-teachers were better fifty years ago, when they turned out an occasional Daniel Webster, than they are now; that all schools are "revolting" to pupils; that the average boy, who has many weeks of vacation per year, is likely to learn the value of time, the necessity of punctuality, and the need of subordination, and to acquire modesty and self-control, order and method, quite as well as he does at school; that the old idea of school, as a place for study in reading, writing, and arithmetic, is the correct one, and all else is to be taught and learned somewhere else; and that such practical affairs as a knowledge of things, tools, and the processes of handicrafts, can not be successfully taught at school, but are learned more quickly and better at home or at work. Professor Woodward, of Washington University, St. Louis, has answered some of Mr. Hale's points. He quotes, from an article of his own, the evidence that the boys in his manual training-school enjoy their school hours with real zest, and remarks on what schools of to-day should teach, as contrasted with the schools of Daniel Webster's day: "When Daniel Webster was a boy, there was not a railroad, nor a telephone, not even a telegraph nor a steamboat, in the land. Our present methods of supplying cities with food, with fuel, with shelter, with clothing, were unknown. There was not an armored ship, nor a breech-loading gun, nor a dynamo, in the world, and one half of the present occupations of men did not exist. Are our schools to be conducted in blissful ignorance of all this?" He adds: "I do not say that schools should teach trades, any more than that they should teach banking, or piano-playing, or telegraphy. They should only teach principles, and methods, and the use of tools and appliances applicable to a majority of the occupations of American civilization; these they should teach for three reasons: 1. Opening the way to an intelligent choice of occupation; 2. Insuring success in the chosen occupation; and, 3. Raising the intellectual and moral standards of manual occupations. It is scarcely necessary to add that three hours per day given to manual training (drawing and tool-work) leave abundant opportunity for literary and scientific training, or that the intellectual development of pupils thus broadly exercised is both wholesome and rapid."

The Medico-Legal Society.—Mr. Clark Bell, in his address on retiring from the presidency of the Medico-Legal Society, points to the high character of the membership of the body as entitling it to that respect and confidence which are now awarded it by students of medical jurisprudence throughout the civilized world. It has three hundred and ninety-four members. Its library has largely increased, by the gift of books from members and honorary and corresponding members, and is now said to be the best single collection of works on medical jurisprudence in this country outside of that embraced in the library of the Surgeon-General's office in Washington. Its list of honorary and corresponding members embraces gentlemen of the highest distinction and eminence in the science of medical jurisprudence, in America and Europe. The constitution of the society has been enlarged so as to admit to active membership persons throughout the United States and Canada. The "Medico-Legal Journal" has a circulation of two thousand copies. The address,

after reviewing the progress of the science in Great Britain, France, Belgium, Holland, Scandinavia, Austria, and Hungary, mentions the organization of the Society of Medical Jurisprudence in Philadelphia, and refers to the progress of the work of the Massachusetts Medico-Legal Society. Mr. Bell is succeeded in the presidency of the society by Professor R. O. Doremus.

Cardinal Pitri on Scientific Studies.—Cardinal Pitri, a prelate enjoying high dignities at the papal court, has appeared as a contributor to the Roman scientific journal "Cosmos" of an article, advising the clergy to cultivate science. "It is a good thing," he says, "for those who have in theology the key to all the sciences, not to neglect any of them. We, too, ought to have our specialists who understand and help us to understand the views of men of learning, and are prepared to meet them on their own ground. While they cherish the science of the sanctuary, the clergy should also be familiar with secular knowledge." Not only this, but "ecclesiastics and members of religious orders, especially those addicted to tradition, should be found among the men of bold speculation and research; for tradition is no less necessary for science than for faith." The cardinal recommends those studies, although they at first sight look dry, as sure to afford "a pure and healthy delight, which grows into enthusiasm in proportion as they are perseveringly cultivated." It must be remembered, he adds, that such studies only tend further to establish "those fundamental verities whence flows more or less directly the explanation of whatever can be explained." For the material universe is "a sealed book" to those who acknowledge no Divine Creator and Upholder of the wonderful forces which surround us on every side. But it behooves the young clergy to be careful against coming to too hasty conclusions in their endeavors to harmonize theology and science. "It is neither prudent nor safe to adopt scientific hypotheses too quickly into the domain of theology and hermeneutics." The observation is enforced by incidents in his own experience, that we have had "modern theologians retreating from explanation to explanation, embarrassed between the periods of the anterior creation": and, while the texts that have given occasion to controversy are "equally inspired with the rest of Scripture," it is "dangerous to apply them unreservedly to each passing system"; and is much more prudent "not to be in a hurry to make a theological thesis of a learned hypothesis and commit one's self to it, when no such obligation is imposed on us by the constant teaching or defined dogmas of the Church."

The Soil-Ferment.—It was determined by experiment, a few years ago, that the capacity of earth to purify sewage from organic matters by oxidation could be suspended by treating the earth with chloroform, but that in time the soil would regain its oxidizing quality. The conclusion was reached from this observation, that the oxidation of organic matters in sewage depends, in part at least, on the presence of small living organisms whose activity could be suspended by dosing them with chloroform. This conclusion has been confirmed by subsequent observations, and it is believed now that the oxidizing property of the soil is promoted by the presence of a micrococcus, which acts most efficiently at a temperature about that of the blood, but more feebly at higher or lower temperatures, while its efficiency ceases entirely at near the freezing-point and above 130° Fahr. It appears to be, in dry soils, most abundant in the upper six inches, and to cease to act at depths below eighteen inches. It has been further determined by these experiments that nitrogenous solutions to be acted upon by the ferment must be alkaline, while acid solutions are not affected. Ordinary house-sewage is slightly alkaline and readily acted upon, but this susceptibility is destroyed when acid-manufacturers' wastes are admitted to be mixed with it, or with the soil.

Evolution of Warlike and of Peaceful Races.—The "Pall Mall Gazette" finds in the doctrines of hereditability and modifiability reasons for supposing that the present Continental organizations of military life may ultimately result, by the weeding out of the warlike, in the development of a more peaceful and industrious race of men.

The cloister-life of the middle ages tended to the increase of the warriors by drawing gentle spirits and those skilled in the handicrafts to the convents, and leaving it to the knights and their retinues to do the marrying and the bringing up of posterity. Now the military establishments of the European empires are working in the opposite direction. They tend to draw the brave and the turbulent from married life, and to leave the raising of families to the industrious and those who shun the field of battle. The effect of the system on the population of France after the Napoleonic wars was visible, and has been much remarked upon. Hence it is probable that the warlike nations are destined to decline, and peaceful ones, like Great Britain and the United States, to prevail, and thus will come to pass the prediction in the Sermon on the Mount, that the meek shall inherit the earth.

The Mole a Friend to Man.—A writer in "Land and Water" pleads for the mole as a much-abused animal which really does more good than harm, fulfilling its mission "of ventilating the soil with many-branched tunnels, and of converting insects, worms, etc., into fertile mold. . . . The ingenuity which the mole exhibits in the formation of his covered ways might stimulate—perhaps has done so—agriculturists to improve their drainage systems; the comminuted earth and other material which he leaves behind him might also instigate them to produce the same results on a scale commensurate with their requirements. . . . We cease to be surprised at the work executed by the mole when we examine its structure. The fore-paws, short and very sturdy, are moved by immense muscles, and are supported by a clavicle of great strength; the broad palms are turned outward, the better to form scoops for throwing earth, gravel, soil, etc., behind while the animal is burrowing. The 'fingers' are small, so much so, in fact, as easily to be overlooked, but each is terminated by a nail, long, flat, sharp-edged, and very strong, eminently calculated as a tool for cutting through the soil. The snout, which we have noticed as furnished with a terminal bone, assists in these operations, and the neck is supplied with muscles of extraordinary vigor." But the hinder part of the animal is undeveloped and feeble, and it is said that the creature can progress more swiftly in the ground than on it. Its sense of hearing is very acute, but it has no external ears, and its eyes are barely visible. Its hair is very fine and stands straight out, so that, whichever way the animal goes, it is not "against the grain." The nest or home in which the mole resides, and in which the young are produced, is worthy of notice. A high arched roof is made by the removal of a quantity of earth; here and there pillars—portions of the solid soil—are allowed to remain as supports. The earth, of which the nest is composed, is pressed and beaten, and with it are mingled grass-stalks and roots to give it a greater consistency, and by this means to make it sufficiently compact to throw off heavy rains. Within the dome is erected a small mound, littered with soft grass and leaves. This is the bed, and from its elevated position is secure from whatever drainage may casually make its way below. From this mound lead off, in various directions, the passages excavated by the animals, and these often extend as far as thirty or forty feet from the central hall." The small mounds dotted over the scene of the animal's labors are merely the soil thrown up while in search of worms, etc., and have nothing in them specially worthy of examination. The mole usually seeks to be near the water, or to have access to it.

Obesity.—Obesity, says the "Lancet," may be promoted or relieved, to a limited extent, by the selection of diet and regimen, but it is fundamentally dependent on some inherent state of being or habit of life. For its safe and effectual treatment, provided the case be not of so long standing as to be beyond all remedy, this state must first be understood and regulated. Whatever interferes with oxidation, or with the due metamorphosis of digested food within the tissues, is apt to lead to its storage in the form of fat. It is, therefore, necessary for health that consumption should be limited as nearly as may be to what is necessary for sustenance, and that discharge of waste and tissue demand should be at the same time encouraged by moderate bodily exercise. The limitation of food should,

however, be in its quantity rather than in its kind, for, if the requisition of mixed food for the health of the whole body be rudely interfered with, some other function may suffer and become deranged. "While, therefore, we are ready to admit that stout persons should be content with a less rich diet than the spare-bodied, we are careful to preserve its essentially mixed character, to limit its consumption in quantity, and to rely for disposal of the products of digestion mainly on regular and methodical physical exertion. There should be no difficulty about this latter, seeing that it may be taken in different forms suited to various ages and constitutional types."

Comparative Value of Disinfectants.—Dr. W. J. Miller, of Dundee, has contributed to "The Practitioner" the results of studies he has made on the efficiency of various disinfectants, in which he used vaccine as the experimental infectious matter. His preference is decidedly expressed in favor of sulphur. Chlorine was found to be a reliable disinfectant, the practical application of which was, however, attended with considerable inconvenience. Potassic permanganate was declared not certain in its effects. It possesses considerable disinfecting power, but is not as certain as it is reputed; but, as a deodorant, when it can entirely cover the offensive matter, it is of great value in the sick-room. Hydrochloric acid, though not generally in use as a disinfectant, is of very certain efficacy. In acetic acid, we have "a ready, safe, efficient and cheap disinfectant." Sanitas failed to verify the claims that had been set up in its favor. Perchloride of mercury is pronounced decidedly inferior in agency to several other disinfectants; but, as it has been seen that the virtue of infective inflammation is destroyed by considerably weaker dilutions of a disinfectant than vaccine, and in view of the weight of authority by which it has been introduced, the author will not presume to throw doubt on its value in obstetrical and surgical practice. The results with chromic acid, creosote, and eucalyptus-oil do not appear to have been definite. Cupralum, in concentrated solution, immediately destroyed vaccine, and ferralum and terebene appeared to have the same power. Seven days' exposure to air saturated with the vapor of camphor, killed vaccine, while four days failed to do so. Chloralum is uncertain. Boracic acid had little effect on lymph, and salicylic acid in saturated solution was little more satisfactory. Davaine found iodine the most certain disinfectant for malignant pustules. Dr. Miller regards vaccine as one of the most suitable viruses with which to make the experiments, for it exhibits stronger powers of resistance against the action of disinfectants than almost any other contagium. Several general conclusions are drawn from the experiments. Thus, while it is very doubtful whether any efficient disinfection of a sick-room can be practiced while it is occupied, still atmospheric disinfection may be useful to weaken the contagium and impair its power of reproduction. Sulphur is the most efficient and convenient substance to employ for this purpose. The skin of the patient, particularly the scarlet-fever patient, should be sponged several times a day with diluted acetic acid, preferably with the aromatic. For the final disinfection of the sick-room nothing equals sulphur. Clothing is disinfected by being exposed, with the fumes of sulphur, to a temperature of about 250°, for three hours in a specially constructed chamber; excreta of patients, by mixture with hydrochloric acid diluted to 1 to 20. For hand disinfection, carbolic solution 1 in 20, acetic acid, and sulphurous acid, are almost certainly thoroughly effective.

The Value of Recess.—The subject of "recess or no recess in schools" was reported upon at the meeting of the National Council of Education in Madison, Wis., last July, and was remanded to the committee for further investigation, and to be reported upon again, at the next meeting of the Council, in July of this year. The committee, seeking facts of experience, has sent out a circular of questions which it desires answered by all persons connected with schools or interested in them. Among these questions, reaching to the merits of the case, are: What effect has the no-recess plan upon the management of your schools, especially in the matter of the pupils' habits or conduct? Does or does not the no-recess plan affect the duties and privileges of the

pupils in such a way as to develop or aggravate in any of them nervous irritation? Does or does not the no-recess plan affect the pelvic organs? Does it or does it not affect the eye-sight? Does it or does it not affect the nasal passages and lungs? How do the physical exercises substituted by the no-recess plan for those of the recess affect relatively the rapidity of the pulse of the pupils, when it is compared to the rapidity developed in the exercises of the out-door recess? Answers may be sent to J. H. Hoose, State Normal School, Cortland, N. Y.

Pacific Coast Panthers.—A correspondent, "Forked Deer," in "Forest and Stream," communicates some notes on the habits of the panther as he has observed them in the Pacific coast region. He expresses surprise that the settlers should have given this animal a different name—California or mountain lion—from the Eastern animal, for the "two panthers are so nearly alike that no one would dream, upon comparing them, of regarding them as distinct species." Yet "the panther of the West coast never indulges, for his own entertainment, in those fierce, cat-like screams with which his Eastern brother occasionally makes night hideous." The correspondent has a growing skepticism in regard to panthers ever willingly attacking a man. "I have known them," he says, "on several occasions to follow persons a short distance, and I have seen wolves do the same thing, especially when I have been packing in freshly-killed meat, but I do not believe that in either case they meditated an attack. In one instance, in the Cascades, near the Hood, I knew a panther to jump at a man as he lay at night in his blankets, but as soon as the man partly arose and shouted for assistance the animal bounded into the brush and disappeared. In talking it over, we all came to the conclusion that the panther had seen the man move under his blankets, and had mistaken him for some less formidable antagonist, and that when the deception was revealed to him he threw up the job at once. . . . That the panther will run from the smallest yelping cur that can be induced to follow his trail is true, but I am satisfied that instinct . . . warns them of the hunter behind the dog, and that it is the latter only which they fear. Panthers ascend the immense trees near the mouth of the Columbia, which are frequently three hundred feet high, and sixty, eighty, or even a hundred feet to the first limb, precisely as a cat would climb them, and when wounded will sometimes go to the very top. Although they may in some places spend the day lying upon the limb of a tree, they are believed to prefer rocky ledges and caverns, where they are accessible, for that purpose."

Cremation of Household and City Refuse.—The ultimate of sanitation, Mr. J. M. Keating, of Memphis, Tenn., argued in his address before the American Public Health Association, last fall, must be by fire. In support of his thesis, he proved by the citation of dozens of instances in the condition of European and American cities, towns, rivers, water-sheets, public institutions, and private houses, that when the people do not complain of polluted water, as they have to do in most cities, they do of sewer-gas; that when resting seemingly secure in an approximately good system of sewerage, they have to complain of the means for and methods of sewage disposal; that by the London method, so exhaustively expensive, the Thames is still nothing better than a wide-open sewer; that the Paris method is only partial, and too expensive, and altogether impossible for large cities; that by the New York method the docks are filled with excreta, and the entrance to the harbor is threatened by bars formed of the street and house wastes, carried out to sea at great expense by barges; that rivers are being destroyed by sewage which kills the fish and make what was once a source of health a permanent nuisance; that as privies and cess-pools are condemned because they saturate the soil, sewers are to be condemned, in some instances, for the same reason, and because they throw off and fill dwellings with sewer-gas, and docks and harbors and rivers with death-dealing sewage; and that all present plans of sewage disposal are defective because they are not final, because they merely contemplate the removal and not the destruction of what is conceded to be the prime factor in promoting and perpetuat-

ing, if it is not the original cause of, much of the disease that afflicts country and city alike. "The next step in the line of progress is cremation, and it has already been taken by thousands of households, . . . who cremate all of their household wastes and kitchen garbage, greatly to their comfort and relief. The kitchen-stove is found to be a convenient furnace, and into this everything but excreta is dumped, to be utterly consumed, and thus put beyond the process of fermentation and slow decay." The method of cremation is to be carried out in London on a large scale, in an establishment which has been erected for the purpose by Mr. George Shaw. Its introduction into all cities would relieve them of a multitude of evils, and bring no new ones in.

Early Mention of Maple Sugar.—MESSRS. EDITORS: Professor H. W. Wiley, chief chemist of the Department of Agriculture, has recently published analyses of maple-sugars and sirups ("Chemical News," February 20, 1885), and says he is surprised to find almost no data concerning the composition of maple-sugars in chemical literature.

I can confirm this observation as to the paucity of information, having had occasion to institute a search for such literature.

I have found an early mention of maple-sugar, which seems to me to be of great interest, and append the extract to this note. The references to sugar from maize and from water-melons are curious, and I should like to inquire of your readers whether experiments on manufacturing sugar from water-melons have been made in more recent times. If so, with what success?

Very truly yours,

H. CARRINGTON BOLTON.

HARTFORD, CONNECTICUT, *March* 14, 1885.

Extract from HON. ROBERT BOYLE'S "*Usefulness of Experimental Natural Philosophy*," *Oxford, 1663, Essay iv, p. 112.*

"Since the writing of these last Lines, being visited by an ancient *Virtuoso*, Governor to a considerable Colony in Northern *America*, and inquiring of him among other particularities touching his Country, something in relation to the thoughts I had about the making of several kindes of Suger, he assur'd me, upon his own experience, that there is in some parts of *New England*, a kinde of Tree, so like our Wallnut-trees, that it is there so called, whose Juice that weeps out of its Incisions, &c, if it be permitted slowly to exhale away the superfluous moisture, doth congeal into a sweet and saccharine substance; and the like was confirmed to me, upon his own knowledge, by the Agent of the great and populous Colony of the *Masathusets*.

"And very lately demanding of a very eminent and skilful Planter, why, living in a part of *America*, too cold to bare Sugar-Canes, he did not try to make Sugar of that very sweet Liquor, which the Stalks of *Maize*, by many called *Indian* Wheat, affords, when their Juice is expressed; he promised me he would make tryal of it: Adding, That he should do it very hopefully, because that though he had never been solicitous to bring this Juice into a saccharine form, yet having several times, for tryal sake, boild it up to Syrup, and employed it to sweeten Tarts, and other things, the Guests could not perceive that they were otherwise sweetened than with Sugar, and he farther added, That both he and others, had, in *New England* made such a Syrrup with the Juice of Water-melons."

NOTES.

THE "Lancet" states that "a marked increase in the death-rate from cancer during the latter part of the present century has for some years occupied the minds of several well-known pathologists in endeavors to reveal its cause." It being generally agreed that the disease is prone to arise out of prior morbid states which do not appear to be directly or necessarily related to it, among which are tissue exhaustion, the "Lancet" adds: "If we admit, therefore, as we consistently may, that tissue-exhaustion, the result of toil, anxiety, or privation, and whether inherited or induced, affords a sufficient basis for the development of cancer, we may not look far into the history of our laborious age to find an explanation of a rise in its death-rate which at first may seem anomalous."

MM. FOL and Sarrazin, of Geneva, have been experimenting on the depth to which light can penetrate the waters of the Mediterranean Sea. They find that at two hundred and eighty metres the effect is about the same as that of a moonless night, and that the chemical rays cease to be felt at four hundred metres. A curious result of their experiments is the discovery that the water of the Lake of Geneva is far less transparent than that of the sea.

DR. JAMES PAGET, of London, has been elected a corresponding member of the French Academy of Sciences in the section of medicine and surgery, replacing M. Bouisson, deceased.

MR. L. P. GRATACAP recently read before the Natural Science Association of Staten Island a paper on chlorides in the rainfall of the island for 1884. The results of his observations on thirty-two rainfalls, or about two thirds of the number that occurred during the year, gave ·228 gramme of chlorine, or ·376 gramme of common salt, as the average amount of those substances that fell with a gallon of water. Taking an average rainfall of 3·5 inches, he was led to the conclusion that, calculated as common salt, the amount of chlorides brought down with the rain in 1884 was 5·10 pounds per acre. Free hydrochloric acid and reactions for sulphates and sulphuric acid were also obtained, probably from neighboring manufactories.

VASELINE has been recommended by some one for shortening in pastry, but M. A. Riche has warned the health authorities of Paris that its use in foods is injurious to health.

AN English translation is about to appear of M. Paul Bert's "First Year of Scientific Instruction." The work has had an extraordinary sale in France, amounting to ten editions of fifty thousand copies each in three years, and is used in nearly all the schools.

PLATINUM has been discovered in New South Wales in connection with gold in the Ophir district; in small grains in the Hunter and Macleay districts; as a nugget, weighing 268 grains, in Wiseman's Creek; and in the sand of the sea-coast near Richmond River.

IN a recent United States consular report, the population of Liberia is estimated at 767,500, of whom 730,000 are aborigines not yet enjoying the rights of citizenship, and the remainder are immigrants and civilized aborigines and their descendants. The Cavalla River, navigable for two hundred miles, has great commercial importance, having an agricultural country with some gold-washings upon it.

OBITUARY NOTES.

GEORGE HELMERSEN, the eminent Russian geologist, is dead, at the age of eighty-two years. Having studied at Dorpat, he accompanied his teacher, Engelhart, along the course of the lower Volga and the Ural; then took part in Hofmann's and Humboldt's explorations of the Ural region. Having been appointed to a position in the Mining Institute of St. Petersburg in 1835, he made vacation geological journeys over the Kirghiz Steppe, through Norway and Sweden, the coal districts of Poland and Silesia, the mining districts of Lakes Onega and Peipus, and the bituminous-coal regions of Kherson and Kiev; and explored the gold-mines of Beresovek. He published numerous memoirs on the results of these investigations.

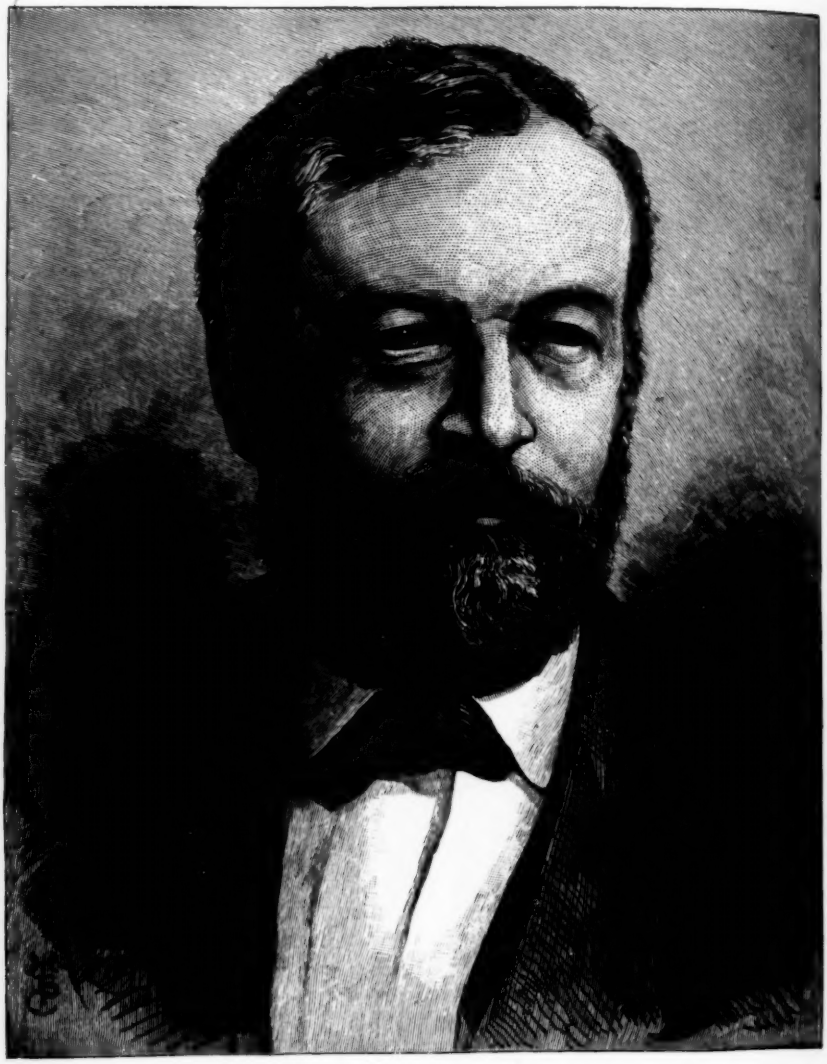
CONCHOLOGY has lost one of its most industrious students by the death of Mr. Geoffrey Nevill, at Davos Platz, February 10th, in the forty-second year of his age. He was a son of Mr. William Nevill, of Holloway, England, who was interested in mineralogy and had a famous collection of Meteorites. Inspired with some of his father's tastes, he began making collections of shells at an early age. With these, and other collections of his own, he enriched the Museum of Calcutta, with which the most important labors of his life were connected. He contributed many papers on his favorite study to the "Journal" of the Asiatic Society of Bengal, and compiled the valuable "Hand List of Mollusca in the Indian Museum," which, however, he was not able to complete, on account of ill health. During the later years of his life, while an invalid, he was engaged in making collections near Mentone and around the Lake of Como.

THE Russian naturalist, Mr. N. Severtsoff, died January 11th, in consequence of the cold following his being plunged into the river Don by his vehicle breaking through the ice. He explored the Thian Shan in 1867, and wrote books on the vertical and horizontal distribution of the animals of Turkistan and on the birds of the Pamir, to which is owing what is known of those subjects outside of Russia.

THE death is announced of Mr. Frederick Field, one of the original members of the Chemical Society, who had been vice-consul in Caldera, Chili, and Professor of Chemistry at St. Mary's Hospital and in the London Institution. He contributed to scientific publications numerous papers on various branches of chemistry, especially on topics relating to the mineralogy and metallurgy of South America.

THE death is reported of Professor Dunker, mineralogist and paleontologist, of Marburg.

SIR FREDERICK PALGRAVE BARLEE, who died in Trinidad last summer while serving as governor *pro tem.* of the island, had done considerable official service to geographical and archæological exploration. As Colonial Secretary of Western Australia, he gave encouragement to Mr. John Forrest's explorations, and had the great Lake Barlee named after him. As Lieutenant-Governor of British Honduras, he extended official support in aid of Mr. H. Fowler's journey across the unexplored part of the colony, and also encouraged and assisted the explorations of Dr. Le Plongeon in Yucatan.



S. P. LANGLEY.